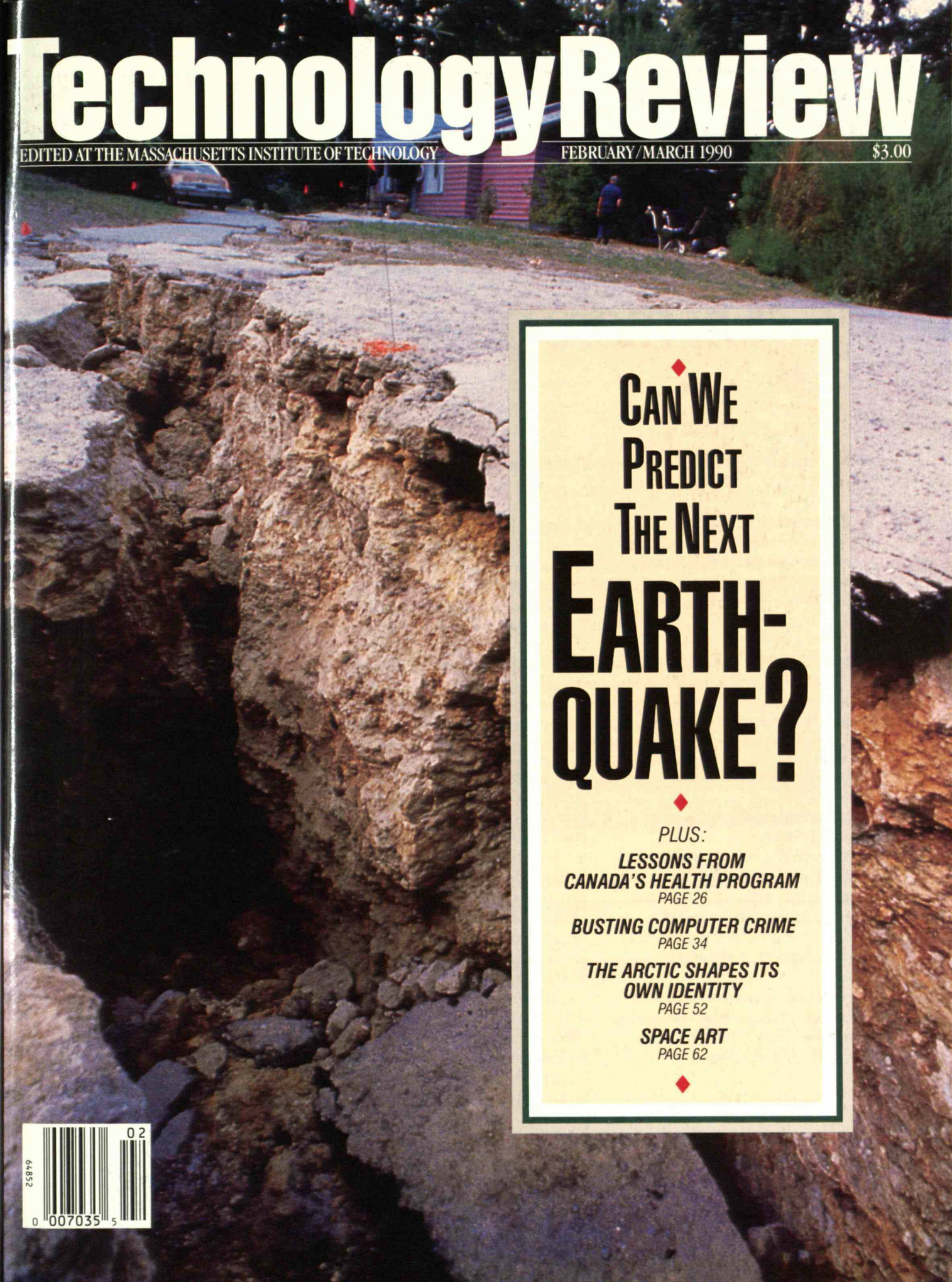


Technology Review

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY FEBRUARY/MARCH 1990 $3.00

CAN WE PREDICT THE NEXT EARTHQUAKE?

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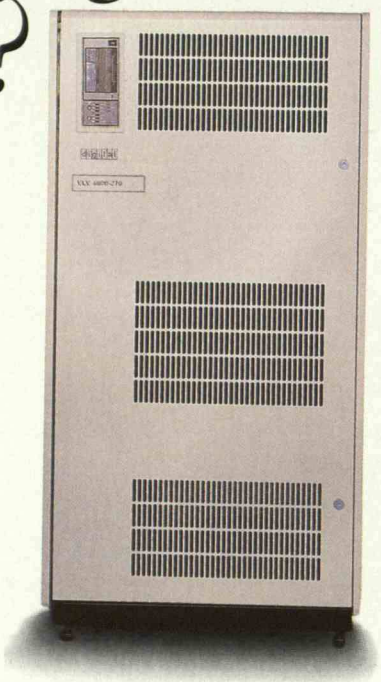
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Dear MIT Parents:

The ***Parents Program*** is pleased to send *Technology Review* to keep you in touch with the issues that concern the MIT community and society.

What a pleasure it was to have so many families and friends on campus during Family Weekend. The information sessions on Friday afternoon, presented by the deans, Career Services, Financial Aid and Medical Department, gave parents and staff an opportunity to talk to each other informally about important matters. Your opinions and questions helped the MIT staff understand the parents' and students' perspective. From these sessions, conversations, phone calls and letters from you, we are continuing to develop the **Parents Program** as a service to MIT families.

An important suggestion developed from the Career Services discussion. As a way of facilitating and supporting the career searches of undergraduates, parents suggested that we form a list of parents and friends who would be willing to give information and advice about their professions to undergraduates and new graduates. Meetings could be on campus, in your home town, or by phone. As you learned on Family Weekend, MIT graduates go into architecture, management, medicine, law, and many other areas, so don't feel that you need to be in science or engineering to offer your help. If you would be willing to give information about your profession to an MIT undergraduate, please write or call us at the above address. We will limit the number of calls you receive, if you wish. We hope that <u>many</u> of you will respond. Providing a network of friends can be very helpful support to young people.

Other ideas surfaced during Family Weekend which could take our new **Parents Program** in exciting directions. If you would like to be part of a planning group, please let us know by calling or sending your name and address.

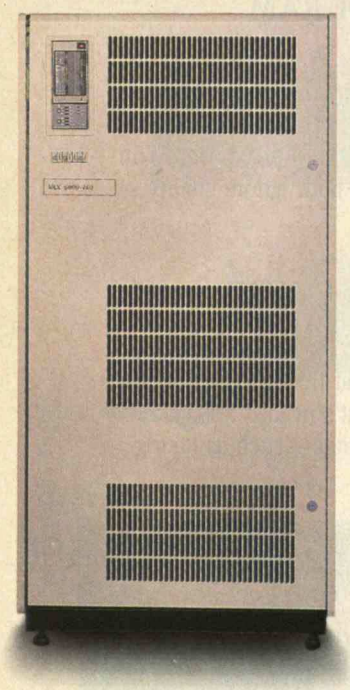
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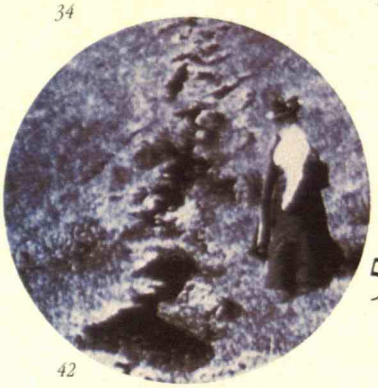
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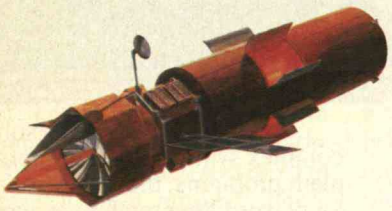


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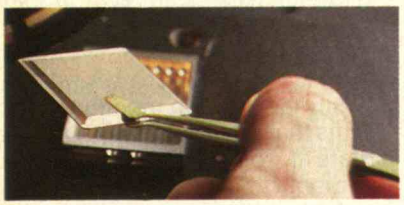
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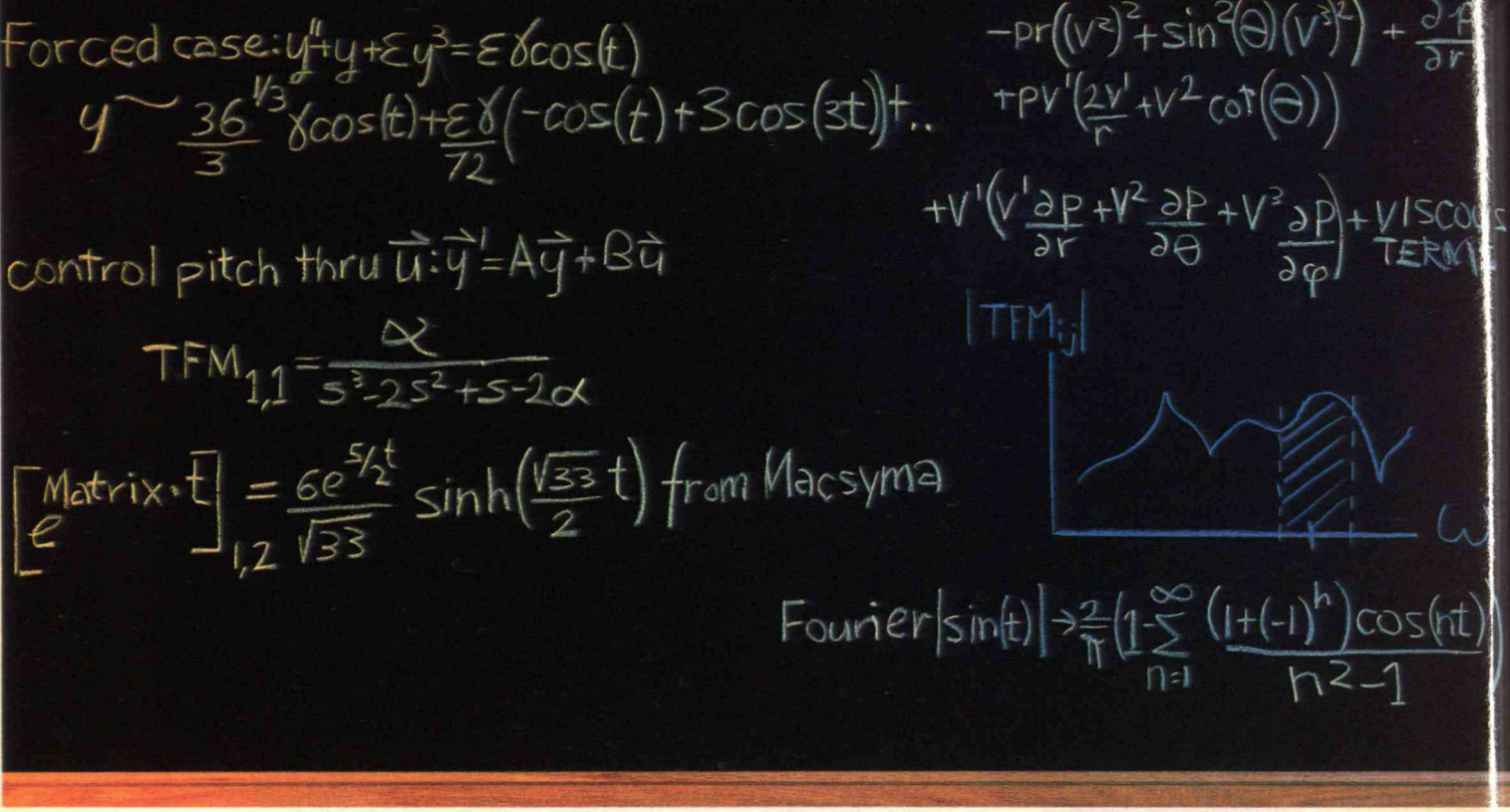
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Why Scientific Education Is Liberal

My "liberal" education pressed resolutely conservative views upon me. Both instructors and authors, especially modern authors, conspired in this. William Butler Yeats saw social change as futile ("mere anarchy is loosed upon the world"). He held up as the symbol of perfection an idealized Byzantium, successor to the eastern Roman empire. For an alternative, one could read T.S. Eliot, who sneered at middle-class notions of progress and would have reinstated the medieval Catholic Church, successor to the western Roman empire. These authors so powerfully evoked the vision of an orderly society that it took me years to realize how reactionary they were.

Key members of the MIT faculty and administration propose strengthening the humanities in the curriculum, even if it means sacrificing professional accreditation for the undergraduate engineering degree. I support the proposals (future issues of this magazine will examine them), but I would offer a caution. The traditional humanistic education is fundamentally conservative. The willingness to confront change—such as revamping the curriculum at a major university—springs more from a scientific cast of mind.

The debate about the merits of humanistic versus scientific education arose in the late nineteenth century when major technical institutions were established. Thomas Henry Huxley, the British biologist and essayist, championed science. Though agreeing with humanists that "perfect culture" should provide "a complete theory of life," he attacked the notion that "literature alone is competent to supply this knowledge." What could all Greek and Roman antiquity say about the scientific revolution that had overturned the medieval theological order and traced our ascent from apes? "For the purpose attaining real culture," Huxley concluded, "an exclusively scientific education is at least as effectual as an exclusively literary education."

The Victorian poet and critic Matthew Arnold supported humanism to the end. "To know ourselves and the world," Arnold declared, we must "know the best which has been thought and said," notably the Greek and Latin classics. Grant that humans had descended from a "hairy quadruped furnished with a tail and pointed ears, probably aboreal in his habits." Grant that science had deflated religion and even philosophy ("pluming itself on its reasonings about finite and infinite being"). Still, poetry remained "to interpret life for us, to console us, to sustain us." Never having claimed literal truth, poetry was the vital repository of understanding about the human condition.

Arnold was broad-minded and generous where Eliot and Yeats were narrow and shrill. He respected science and the idea of progress. Still, his championing of "the best that has been thought and said" embodied a fundamental conservatism. That resistance to change goes right to the origin of humanism: the poems of Homer, which Arnold loved to quote in the original Greek.

Homer composed *The Iliad* in about 725 B.C. at a time when Greek-speaking peoples were making rapid technological progress based on improved iron metallurgy and were being flooded with foreign influences—vase painters were borrowing Oriental designs, and the alphabet itself was imported, probably from Syria. Homer was clearly troubled by the decay of Greek traditions. Even more intensely than Eliot or Yeats, he evoked an idealized past—a golden age when heroes observed the old traditions, and poets immortalized their fame. The Western tradition was forged out of a concern about its own demise.

Given such a tradition, proposals for change at liberal-arts institutions tend to be met with a frown. Only after weighing the myriad failures that have dogged humans since the days of the ancient Greeks and Hebrews dare one risk a step. The ghost of the medieval university—rather a fantasy of it as a priesthood of scholars sheltered from society, cradling truth—decries novelty. This was so during the 1960s when I was at school and no less true in the 1980s, when William Bennett, the Reagan Administration education secretary, served as clumsy standard-bearer for the Western tradition.

By contrast, science readily grapples with change: developments for good or ill ranging from the exploitation of fossil-fuel energy to the advance of artificial intelligence. Technologists are, in my experience, remarkably willing to discuss their successes, their failures, and how to do better. As with the curriculum proposal, when someone suggests change at MIT, the response is likely to be: it's an experiment, and perhaps we should try it.

I suspect that science and engineering are open to change because the disciplines are based on experiment, even failure. Civil engineers recall the bridge over the Tacoma Narrows in Washington State. Because of the imperfect state of the art at the time, the designers did not adequately brace the bridge. A wind in a certain direction would set up a harmonic motion, until the steel and concrete structure began to oscillate like a slow-motion violin string. When the right wind blew long enough, the bridge snapped.

The most important lesson from the Tacoma Narrows is not about cross-bracing but about risk. Whether the forces are stresses on a bridge or pressures for social improvement, no reading of the past can fully analyze or predict them. That is no excuse to avoid action: many things in our world need fixing. To attempt that—to bridge a narrows or improve an institution—involves risk and possible failure. Failure is serious but is also an opportunity to learn. Literary education looks to the past, but scientific education looks to the future and is no less humanistic. ■

JONATHAN SCHLEFER

TechnologyReview

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Letters

WHO'S TO BLAME FOR WEAPONS-REACTOR PROBLEMS

John Ahearne's article on the sorry state of our nuclear weapons facilities (*"Fixing the Nation's Nuclear Weapons Reactors," TR July 1989*) was excellent. The reactors managed by the civilian side of the Department of Energy (DOE) are much safer and more reliable. They have their own very strict standards, and their records speak for themselves.

There is plenty of blame to go around for the problems now confronting the defense side of DOE. The underlying cause is the unwritten policy that once an operating contractor is selected, the Washington bureaucrats in the department should not interfere—just obtain funding from Congress and make sure production goals are met. Somehow these officials have hoped to simply blame the contractor for any problems that might arise. For this reason, the DOE field offices at defense sites have been powerless to cope with difficulties and reluctant to report them to Washington. To outsiders the field offices have given the appearance of working for the contractors rather than for the government.

Another part of the DOE—the assistant secretary for environment, safety, and health (ES&H) and its predecessors—has aided and abetted the hands-off policy. Assigned the duty of confirming compliance with DOE management directives, this organization ended up whitewashing almost all field operations. As an example of how bad the situation was, in the early 1970s the director of the DOE's reactor development and technology program had to ask the director of ES&H to stop undermining his programs; ES&H had been telling the field offices and contractors they did not have to comply with directives on DOE safety policies.

Congressional delegations from states with DOE production facilities are also at fault, since their close association with DOE field offices and contractor managers has been a major influence on the effort to cover up deficiencies. These politicians didn't bail out until the media began to publicize the current environmental and safety hazards. Congress is to blame for failing to fund new production reactors as well.

Finally, DOE contractors have been less than forthright. Faced with aging facilities, they have not taken a strong position against continued operation, preferring instead to nurse along equipment that is obsolete and dangerous. DuPont, for example, operated the C-reactor at the Savannah River plant for several months after it was confirmed that a series of slightly leaking cracks in the lower knuckle of the reactor vessel had reached an effective length of 200 inches.

One area of Ahearne's article needs clarification. He quotes Louis Roddis to the effect that public hazards from weapons plants could exceed those of commercial reactors. But since all the DOE reactors are located on large, remote sites owned and controlled by the government, those at risk are mainly the thousands of workers there. Very few members of the general public live within the emergency planning zones established by the Nuclear Regulatory Commission and implemented by DOE. Also, the risk at DOE sites is intended to be no greater than that at commercial reactor facilities. Having been associated with the emergency-planning program established to achieve this goal, I believe that the worst consequence of a major accident would be the loss of the facility. The effect on the health of those involved would be minimal, if any.

I don't know where John Ahearne got the idea that the Energy Department was surprised at the Roddis panel's highly critical report on Hanford's N-reactor. That can't be correct unless he's referring only to incoming appointees when the report came out in 1987. During the latter part of 1980, a team of DOE experts was convened to assess the safety of DOE reactors by applying the lessons learned from Three Mile Island. The team pointed out all the same problems identified by the Roddis panel, as did the National Academy of

Sciences later on. However, defense reactors had had no major accidents in the past 30 years—only near misses and "unusual occurrences" that were reported informally to DOE field offices if at all—so there was little impetus for those in charge to make any changes.

I hope the new advisory committee that John Ahearne chairs and the defense safety board that Congress has recently spawned will function as well as their commercial counterparts. If so, they should be able to provide DOE management with the independent advice needed to enhance safety at defense facilities. But it remains to be seen how well this will work in the face of political pressure from Congress and the antinuclear minority. Positive findings of safety are frequently diverted by these pressures, especially when the findings are intended to correct previous regulatory excesses. Sometimes the result is actually a reduction in overall safety levels, particularly when funds have to be siphoned off into less effective or even unnecessary improvements. DOE should do everything in its power to avoid such problems. To succeed, it needs the full support of administration leaders, the Congress, and the new safety panels.

PETER J. DAVIS
Paris, Va.

I thoroughly enjoyed John Ahearne's article "Fixing the Nation's Nuclear-Weapons Plants." However, Louis Roddis is a past president of New York's Consolidated Edison, not Chicago's as stated in the article.

W.M. KIM RODDIS
Lawrence, Kans.

More on Reactors in Orbit

Michael G. Houts's letter (*"Reactors in Orbit," TR November/December 1989*), which responds to my article "Let's Ban Nuclear Reactors from Orbit" (*TR May/June 1989*), claims that the proposed ban "would simply hinder any future large-scale use of space," and that "the U.S. SP-100 reactor will not operate in orbits with less than a 10-year decay time."

Actually, U.S. officials had earlier agreed to operate reactors only in orbits high enough to prevent reentry into Earth's atmosphere in less than 300 years. So a 10-year orbital decay time represents a significant retreat.

Moreover, a Jet Propulsion Lab (JPL) study of possible civilian uses for space reactors concentrates mainly on power for space exploration and for bases on the moon or Mars—applications that my article endorses. The JPL report explicitly rejects use of reactor power for NASA's space station because of the massive shielding required to protect astronauts.

Finally, it remains to be seen whether microgravity manufacturing and the other orbital uses of reactors Houts mentions will actually turn out to be technologically attractive. And even if they do, they may not require reactors. In any case, such applications are decades in the future, and a temporary ban on orbiting reactors would hardly hinder them. The applications for which orbiting reactors are now being used by the Soviets and developed by the United States are military, and they are thus a legitimate target for arms control.

JOEL R. PRIMACK
Santa Cruz, Calif.

Biotech Regulation in Perspective

Since I arrived at MIT, where I have directed the Biohazard Assessment Office for the past 13 years, I have had the opportunity to discuss and debate contemporary biological R&D with Sheldon Krimsky, who, together with Kostia Bergman, Nancy Connell, Seth Shulman, and Nachama Wilker, wrote "Controlling Risk in Biotech" (*TR July 1989*). I have become uniquely impressed with Krimsky's dedication and conviction. Krimsky is convinced that regulations help people—that they prevent exposure and eliminate accidents. However, he is wrong. Regulations simply provide a framework for identifying,





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Moreover, Krimsky refuses to accept the remarkable track record of biotechnology. Exposure to recombinant DNA has yet to result in a single recorded infection, illness, or ecological disaster. No one has even reported a minute of lost time. Krimsky compares today's biotech industry with the synthetic-chemical industry of the 1940s and 1950s, which unwittingly released thousands of dangerous substances into the environment, but the comparison is not apt. You can look at any industry you want and you will not find a safety record to match that of biotechnology. Does this mean biotech is safe? No, it does not. It means that we are dealing with a low risk.

Krimsky and his co-authors comment that if an engineered organism happened to escape, "the current regulatory regime would be unprepared to deal with the ecological upset." The question is, though, how any regulatory regime could be prepared to deal with an ecological upset. The only regulatory action that could prevent ecological or health-risk problems would be to ban research outright. I truly hope Krimsky is not regressing to that period in 1977 when he espoused such a philosophy.

Krimsky et al. go on to complain that the biotechnology industry "brings with it a new form of waste" requiring a completely revamped regulatory framework. This is pure hogwash. The waste is not new because biotechnology is not new. The Environmental Protection Agency has not regulated biological waste or infectious waste because no information indicates that it is hazardous.

Furthermore, natural selection, not Krimsky et al., will determine whether any of the organisms released into the environment will become reproductively fit. As for the charge that many engineered organisms are "designed to survive inside humans" and that lab workers can therefore "serve as pathways for releasing the organisms," I would like to know exactly which organisms the authors are referring to. If they mean *E. coli*—and frankly I don't know what else they could mean—then nature itself has done the engineering.

Krimsky and his co-authors also fail to distinguish between organisms that have a predator and those that don't. For example, kudzu, an engineered plant that has become a major weed problem in the Southwest, is not native to this environment and so is more difficult to keep in check. By contrast, the ice-minus experiment reintroduced organisms into their native environment after they had been genetically altered in the laboratory.

Finally, the authors are mistaken in arguing that biotech could place farmers at an economic disadvantage. These writers do not appreciate the importance of technology transfer, and do not understand that biotech could enable us to produce food with fewer resources or under unfavorable conditions. Perhaps we could even develop technology to help solve the world hunger problem.

Krimsky and his colleagues have used *Technology Review* to present a view that is misleading at best. What's more, they present that view as fact.

DANIEL F. LIBERMAN
Cambridge, Mass.

Sheldon Krimsky responds:

Liberman is unambiguously correct on one point. I do believe that regulations can serve a preventive role—for example, in controlling auto emissions, chemical exposures, and releases of infectious waste and genetically engineered organisms. My co-authors and I take a cautious approach to biotechnology, holding that some intentional releases of modified organisms may damage the environment—a position that leading ecologists share. Detailed

Continued on page 78

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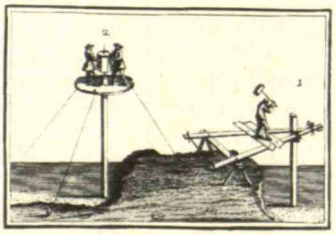
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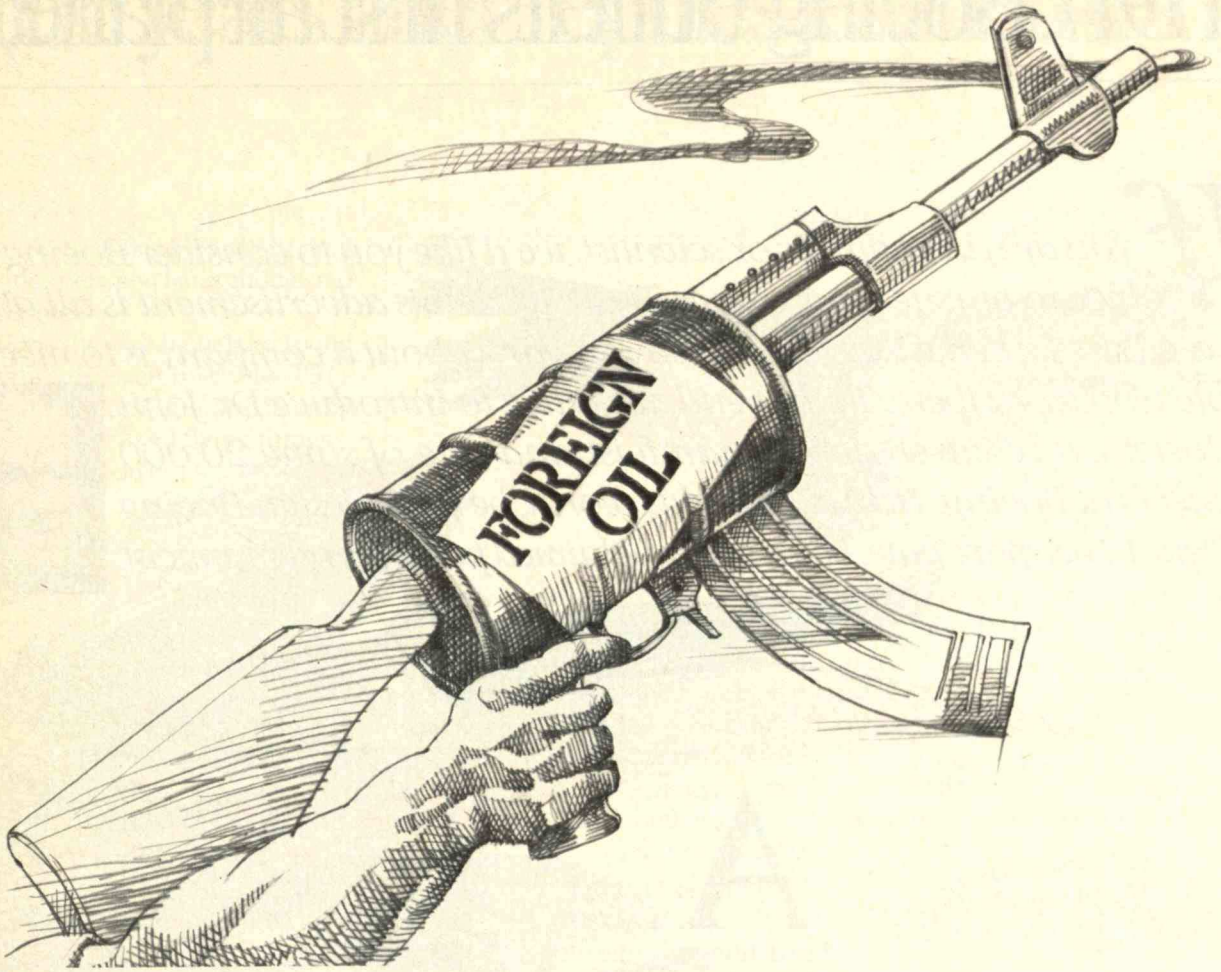
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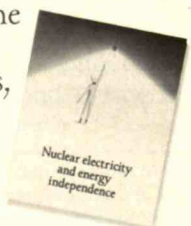
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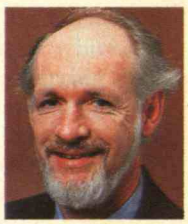
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In 1917 Boeing built its first airplane, 20

If you are an engineer or scientist, we'd like you to consider Boeing as a place to pursue your career. That's what this advertisement is all about. It's based on the belief that a good way to learn about a company is to meet the people who work there. To that end, we'd like to introduce Dr. John McMasters, a research aerodynamicist and one of some 20,000 engineers at Boeing. In his workaday world, he helps design Boeing jetliners. In his spare time, he's a self-proclaimed paleoaerodynamicist.



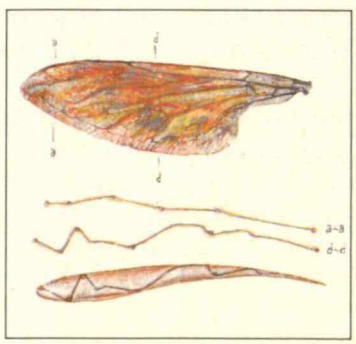


Ask Dr. John McMasters to define the proper field of study for an airplane designer and he'll say, "Everything that flies. All the time, professionally and avocationally."

That includes jetliners, certainly. And also insects, seeds, birds, bats, a certain reptile that executes aerial maneuvers of surprising grace and precision, hang gliders and boomerangs. Plus things that once flew, but don't now, such as pterosaurs.

Especially pterosaurs, in fact. They dominated flight for 120 million years and, reptiles or jets, all flying things encounter the same basic problems.

Sit back and ask McMasters to elaborate. It's a fascinating story.



The irregular surface and tubular structure of insect wings are an elegant solution to a very difficult flight problem.

You'll learn that 20 years ago, as a graduate student, he embarked on what he now describes as a ridiculously complex enterprise: the study of general locomotion.

"It was not the least bit modest," he says. "I envisioned a grand theory of optimal locomotion embracing the entire range of natural and man-made devices traveling through the air, on land, and in or on water."

His unified theory remains elusive, but the search has been hugely rewarding.

McMasters' investigations have included jumbo jets, bat wing architecture, the wing geometry of soaring birds, the

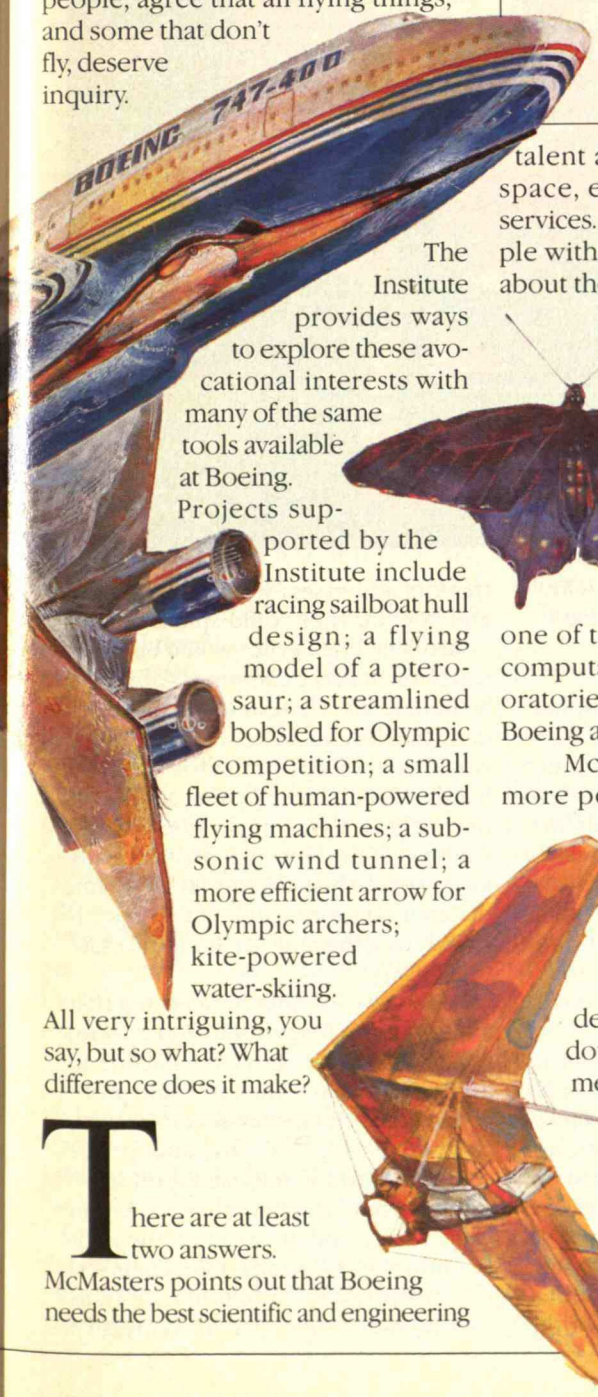
million years after reptiles learned to fly.

complexities of flapping flight, and similarities between hang gliders and flying reptiles.

Along the way, he helped found the Flight Research Institute (FRI). Members, including many Boeing people, agree that all flying things, and some that don't fly, deserve inquiry.



The pinion feathers at the wing tips of large land-soaring birds are a natural model for winglets on the newest Boeing 747 jetliner.



The Institute provides ways to explore these avocational interests with many of the same tools available at Boeing. Projects supported by the Institute include racing sailboat hull design; a flying model of a pterosaur; a streamlined bobsled for Olympic competition; a small fleet of human-powered flying machines; a subsonic wind tunnel; a more efficient arrow for Olympic archers; kite-powered water-skiing.

All very intriguing, you say, but so what? What difference does it make?

There are at least two answers. McMasters points out that Boeing needs the best scientific and engineering talent available in aviation, aerospace, electronics and computer services. The company looks for people with ideas and a lively curiosity about the world and its possibilities.

Boeing supports inventive minds in many ways, contributing to higher education, helping employees pursue advanced degrees, creating courses and institutes if necessary, including one of the world's most advanced computational fluid dynamics laboratories—one of the tools used by Boeing aerodynamicists.

McMasters' second answer is more personal: "What began as a naive but serious enterprise has become a sort of merry drunkard's walk through a range of fascinating topics.

"My inquiries continue, despite suggestions from some doubters that there's little commercial value in designing better butterflies, and thus no merit at all in understanding how they work. I believe understanding the principles of flight helps make one a better designer of devices that do have commercial value.

"Equally important, I believe it's periodically valuable to stand back from the details of a career to see a whole picture—to see one's work in full perspective.

"The effort can be immensely refreshing. And humbling."



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Dr. McMasters is a research aerodynamicist at Boeing Commercial Airplanes Division. He has taught at Purdue University and Arizona State University and has written 65 technical papers, reports and articles. He is preparing a book on the Biological Origins of the Aeroplane. McMasters is a graduate of the University of Colorado and Purdue.

BOEING

MIT Reporter



A warning system could prevent fires like the one that blazed after the earthquake struck San Francisco last fall.

Reducing Disasters During Earthquakes

One of the most fearsome scenes following last October's earthquake in the San Francisco area was the fire, started by gas piping, that raged over an entire city block. A warning system sounding alarms one or two minutes before a quake strikes a city could reduce such disasters. Alarms could ring in key sites, such as utilities, where gas mains could be turned off in advance.

Around the country, perhaps a half-dozen scientists are working on so-called real-time earthquake warning systems. These are based on the principle that seismic waves travel more slowly than radio waves. Using satellite transmissions, the systems would make connections between critical services and instruments measuring ground movements.

At MIT, a team led by professor M. Nafi Toksöz of the Earth, Atmospheric, and Planetary Sciences (EAPS) Department has developed a computer program so such systems could analyze tremors near the San Andreas fault line. In 10 seconds the program can assess a quake measuring 6 on the Richter scale, which would give communities 20 miles away 10 seconds of warning. Orange County, 200 miles away, could learn of the same quake as much as 100 seconds in advance.

The system that Toksöz, EAPS visiting scientist Anton M. Dainty, and former EAPS graduate student John T. Bullitt envision would rely on "strong-motion accelerometers." Bolted into the earth, these instruments would measure the velocity and acceleration of ground movements. The accelerometers would send data to a faraway computer so that it could analyze the magnitude of the tremors and assess where they started and how far they could spread.

Artificial intelligence would be a critical element in the computer's ability to assimilate the thousands of pieces of data quickly. In fact, so much work would be involved that the Toksöz group has pared it down by writing a program that only analyzes quakes on the San Andreas fault. Since scientists already know so much about this fault system, the computations can be fairly specific, reducing the time needed to produce warnings.

After the computer has decided that a quake has a magnitude of at least 6, it would send an alarm via satellite to a variety of sites. Contacts would probably include emergency-response agencies, hospitals, and fire and police stations. Warning television and radio stations could also be valuable, Anton Dainty says. And the system could notify industry locations like chemical plants that use hazardous materials, as well as the computer data centers of

PHOTO: SHAHN KERMANI, GAMMA-LIAISON

banks. By simply switching to emergency power and retracting the magnetic heads of disk drives from computers, operators could protect the enormous amounts of funds moved electronically these days. Otherwise, the shaking ground could cause the heads to touch the disks, ruining data.

The Toksöz team says their computer program has successfully recognized earthquakes when it was fed data from two past episodes: Imperial Valley, which occurred in 1979 and measured 6.6, and Morgan Hill, a 1984 event that registered 6.2.

But the real challenge for the program is in not issuing false alarms, something that still has to be tested, Toksöz says. Needless disruption of services is a nuisance and can be costly. More important, crying wolf can lead people to ignore warnings.

The system will have to be tested under real conditions to determine, among other things, whether difficulties crop up with transferring information from the computer to chosen sites. Toksöz estimates that a field test of three years, during which time at least several quakes will probably occur, will cost $1 million. Implementation eventually might run from $10 million to $20 million.

Toksöz's program is among three that a National Research Council (NRC) commission is looking at while preparing a soon-to-be-issued report on real-time earthquake warning systems. In fact, the panel, which includes Toksöz, is developing its own far-reaching approach. It is proposing a system that would spread accelerometers throughout a quake zone to help emergency services recognize immediately after a quake which areas have shaken the most. Such a system would have been helpful during the recent earthquake, when Santa Cruz was cut off from outsiders for hours. No one knew how strong the quake had been in that city, so it wasn't clear how much assistance was needed.

Panel chairman I. Selwyn Sacks, a Carnegie Institution of Washington seismologist, points out that some real-time earthquake warning systems have already been put to use. In Japan, bullet trains stop automatically when sensors on their tracks recognize the start of a quake. And a rudimentary warning system—with temporary radio links, limited computational ability, and accelerometers—was set up after last October's quake so that workers clearing destabilized sites could escape the effects of strong aftershocks.

Despite the cost, "I think this is an idea whose time has come," Sacks says. "I'm sure there will be an impetus after the last earthquake," whose damage is estimated at $5.6 billion.—*LAURA VAN DAM edits MIT Reporter.* ■

EXAMINING MEMORY LOSS



As Vernon M. Ingram sees it, everyday processes like thinking and memorizing—even watching television—can, over time, cause a decline in such cognitive functions as the ability to learn. Ingram, an MIT biology professor, postulates that this occurs through the death of certain clusters of brain cells.

Ingram's theory could lead to strategies for slowing cognitive problems, and perhaps even restoring some memory and learning ability. This might be particularly important for victims of Alzheimer's disease and Down's syndrome. Ingram and his technical assistant Barbara J. Blanchard have found that in these people cells in the locus coeruleus—a part of the brain that sends out a chemical to help process information—deteriorate much earlier and more completely than in the normal population.

From studies of brains, scientists know that many stimuli cause the chemical glutamate to be released onto the surface of nerve cells in the locus coeruleus. The nerve cells—neurons—then release noradrenaline, which aids higher centers of the brain that process incoming information. But glutamate also causes the neurons' calcium levels to surge briefly, activating enzymes that can break down the proteins in these cells. Most of the protein fragments are reassembled through other activities in the cells, but a minuscule amount of unusable leftovers remain.

Ingram theorizes that the leftovers slowly accumulate and finally choke the neurons. Over time, clumps of dead cells and tangles of neuron fibers prevent the locus coeruleus from doing its job.

In the future, it might be possible to halt this process by giving people drugs that reduce the flow of calcium through cell membranes. This could decrease the calcium levels that glutamate stimulates in neurons, Ingram says. Alternatively, he suggests tests to determine how effective it would be to administer simultaneously the precursors of noradrenaline and another chemical—acetylcholine, which is emitted by another portion of a healthy brain. Acetylcholine also aids in information processing. Increasing the amounts of these precursors would start a chain of events that would eventually send noradrenaline and acetylcholine to higher centers of the brain.—*WILLIAM J. CROMIE, The MIT Report.* ■





Vernon M. Ingram (right) has produced this computer image, which shows that people with Down's syndrome and Alzheimer's disease have fewer surviving cells in the brain's locus coeruleus as they age.

CHART: VERNON INGRAM; PHOTO: W.J. CROMIE

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THEORETICIANS AND FACTORIES

Basic science played a major role in World War II. It led not only to the atomic bomb but to less cataclysmic, more militarily critical developments such as radar, largely a product of MIT's Radiation Laboratory. After the war, science gained ascendency over engineering in the eyes of the public, government, and academia. Today, much of the MIT faculty believes that in introducing a rigorous science-based curriculum, the Institute slighted its traditional strengths in hands-on technology.

Professor H. Kent Bowen saw this process occur. For example, he watched as machine shops, almost ubiquitous on campus in the late 1960s, dwindled until only a few remain today. As co-director of Leaders for Manufacturing, a program of the Schools of Engineering and Management, Bowen seeks to help manufacturers improve their operations and managers understand the shop floor. The question is whether theoreticians such as Bowen, who got tenure for work more closely akin to solid-state physics than manufacturing, are likely to succeed.

"We're sorry we don't have more faculty in Leaders for Manufacturing with experience on the shop floor," says Bowen. He and the other co-director, Professor Thomas L. Magnanti, have recruited some such faculty, such as Don P. Clausing, formerly of Xerox, and are looking for others. Senior executives from the industrial sponsors—11 large firms from Alcoa to United Technologies that have invested tens of millions of dollars in the program—meet regularly to help set the research agenda and curriculum. Managers and engineers from the companies teach courses.

However, if industrial managers knew all they needed to about manufacturing, they wouldn't be supporting the program. They have turned to academia because they haven't succeeded alone, says Bowen: "They tell us they need academics' help. At MIT we study principles. It sounds to us as if there must be some fundamental problems underlying manufacturing. If we can find a central core, then we can study it."



H. Kent Bowen, co-director of MIT's Leaders for Manufacturing program, says that industrial managers have asked academics for help in understanding the shop floor.

PHOTO: L. BARRY HETHERINGTON

The first 20 fellows are now working in teams to solve problems the sponsors have posed. They spend time at the companies and must deal with practical issues such as procuring parts, working with unions, and finishing on time. "This is the real world," Bowen points out.

Leaders for Manufacturing is seeking to change Institute priorities by recruiting widely respected faculty who have credentials in fields important to production—for instance, David H. Staelin of Electrical Engineering, John B. Heywood and Warren P. Seering of Mechanical Engineering, and Thomas A. Kochan of Industrial Relations.

"At MIT, whatever the topic has been, if you've attracted the best and the brightest, a magic has seemed to come out of it," says Bowen. The hope is that this aspect of MIT's wartime experience will be replicated for industrial ends. ■

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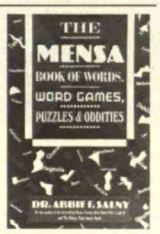
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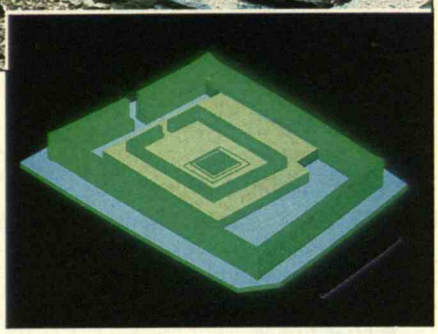
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Trends





Computers "recreate" Nan Dowas, an ancient war fortress on the Pacific island of Pohnpei. Started 1,500 years ago, the community extended a mile into a lagoon.

Paradise Refound

Sometime around A.D. 500, when many European cities were taking shape, a group of industrious people on a tiny island in the Pacific Ocean began a city of their own. They called it Nan Madol—"between the spaces"—and the name aptly describes the city's labyrinthine design, its eerie perch between land and sea, and its remote, long-forgotten location.

Constructed steadily over centuries, this Micronesian city was—in its design and execution—unlike anything the world had ever known. From quarries several miles inland, the islanders moved thousands of massive stone columns out to the coast. There they erected a city in the shallow lagoon, standing the many-ton stone columns on end so they towered 20 to 30 feet above the highest tide. The builders filled in the stone-framed structures with broken coral, forming strong retaining walls and foundations.

Eventually the complex became a canal city extending a mile into the lagoon, including nearly 100 human-made islets separated by intricate maze-like waterways. The small, artificial islands formed residential areas, temples, administrative headquarters, and tombs for the culture's royalty and elite. Upon completion, the complex housed as many as 1,000 people.

On the mostly deserted southeastern side of the remote Pacific island nation of Pohnpei, thousands of miles from any mainland, the stone structures of this majestic city still stand. They rank among the most mysterious and least-studied of the world's major archeological sites. Knowledge of the city's appearance and functions has been mostly lost, wiped out when warring invaders from nearby islands destroyed much of the civilization in the 1600s. Several centuries later, Western settlers brought disease, eradicating much of what remained.

Now, however, University of Oregon archeologist William Ayres has revealed some of Nan Madol's secrets. To Ayres, there is "no other site like Nan Madol in the Pacific—or anywhere." His work has required him to spend most of the past 12 summers charting and excavating the site, aided by a small team of American and Micronesian researchers.

In addition to conventional archeological approaches, Ayres has made pioneering use of a now-common architect's tool: a sophisticated computer-aided design (CAD) system. With this novel technique, Ayres has produced three-dimensional simulations of the walls, houses, and religious sites as they once stood.

Ayres first makes measurements and drawings at Nan Madol, then enters them into the system so he can "pick up" fallen stones on the computer screen and place them in their most likely original niches. Thus, on the computer, he has mapped and "recreated" the islet of Pahn Kadira, believed to be the site of the highest chief's private residence and temple.

Last summer, Ayres completed a simulation of the well-preserved Nan Dowas, or war fortress. He has also studied Nan Madol's islet of Pahnwi—home to a seawall of monoliths reminiscent of Easter Island—and the islet of Nan Mwoluhsei, where warriors may have proved their bravery by jumping off a huge boulder.

Through excavations and computer recreations, Ayres has begun to paint a picture of a Nan Madol that was far richer than that of some earlier theories, which held that the site consisted primarily of tombs of island royalty. Differences among the physical appearances of some of the "recreated" structures lends credence to the view that they served widely var-

PHOTO/ILLUSTRATIONS: WILLIAM S. AYRES

ied purposes and were erected over a long span of time. Differences in the types and amount of pottery shards and other artifacts further substantiate a more complex view of the activities that took place at Nan Madol.

Computer-Aided Archeology

Pohnpei legend holds that Nan Madol was founded by two magicians who caused the stone structures to fly into place. But Ayres says the CAD system sheds an alternate light on Nan Madol's origins. By carefully dating the deposits of wood charcoal layered in the fill of the stone structures, he is discerning "the sequence of building." He now believes that the buildings at Nan Madol were constructed over as many as two centuries. Using his computer, Ayres graphically depicts how the site was "gradually remodeled over the centuries."

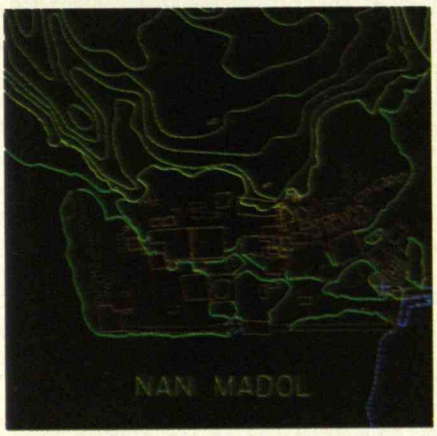
This work has led Ayres to believe that the rocks that form Nan Madol were quarried at least seven miles away and transported by raft or canoe during high tide. According to his research, the war fortress Nan Dowas alone consists of at least 45,000 tons of building material. Combining this with other evidence about the religious basis of early Pohnpeian culture, Ayres says Nan Madol may be one of the few great architectural projects in history built voluntarily.

Although Ayres disputes the label "pioneering" for his computer work, he knows of no other archeological team using computers in quite the same way. "I think it may be starting to catch on, but frankly I'm surprised there aren't more archeologists using CAD systems," he says. "After all, given our focus on ancient architecture, it makes sense we would use the same tools that architects use."

The fact is that CAD systems are just beginning to percolate into archeology. Fred Limp, a University of Arkansas archeologist who specializes in computers, says, "People like Ayres are really at the cutting edge."

Limp adds, "We're still just beginning to see the computer's impact on the field." He notes that some archeologists take a computer to a site to log in the coordinates of material found at excavations. Other researchers use computer-enhanced map systems to help them decide where to dig. Still others are starting to model past conditions, inferring factors such as climate and vegetation that might have affected an ancient culture.

For his efforts, Ayres has become something of a celebrity on Pohnpei, and residents feted him on a recent visit with a traditional feast. He even has a local protégé, Rufino Mauricio, the archeologist's field director in recent years. This year, under Ayres's tutelage, Mauricio will be the first islander to receive a doctorate in archeology and historic preservation.



This computer-generated map shows some of the nearly 100 buildings at Nan Madol. Blue lines mark the borders of deep lagoons.

The University of Oregon degree should come in time for Mauricio to play a major role in a planned open-air museum at Nan Madol. Based on Ayres's simulations, the Pohnpei Historic Preservation Program intends to restore and reconstruct part of the original settlement. ■

SETH SHULMAN writes regularly for Technology Review *and is working on a book about military toxic wastes.*

Star Wars vs. the ABM Treaty

When is an anti-ballistic-missile weapon not an anti-ballistic-missile weapon? When it's an anti-satellite weapon.

That's the sort of contortion the Defense Department goes through to support its case that some Strategic Defense Initiative (SDI) experiments don't conflict with the 1972 Anti-Ballistic Missile (ABM) Treaty. However, the reasoning may open loopholes that the Soviet Union could wriggle through just as easily as the United States.

Without question, the ABM Treaty blocks deploying SDI. More relevant to current experiments, the agreement also prohibits *tests* of space-based defenses. In SDI's early days, compliance was easy, since work was still in the laboratory stage, where the treaty couldn't touch it. But now, seven years after President Reagan launched Star Wars, "the program is maturing," says O'Dean Judd, chief scientist for the Pentagon's Strategic Defense Initiative Organization (SDIO). Even with the slowed funding of SDI, "You're facing the issues now of whether you can really make these things work."

Since developing SDI will increasingly require tests in space, the Pentagon has established an elaborate review procedure to ensure that research complies with the treaty. But even so, some treaty provisions are open to interpretation, such as a ban on testing any weapons system "in an ABM mode."

One of the more controversial projects is Zenith Star, for which small-scale tests could be orbited in 1993, although budget problems have delayed the main experiments to the late 1990s. This would test an orbiting chemical laser that could form the basis for an ABM weapon. To avoid the prohibited "ABM mode," the experiment would shoot the laser at a



At Edwards Air Force Base last September, the Defense Department conducted a 12-second flight of a facsimile of a space-based interceptor. But extending such tests into space with the projected Zenith Star experiment (below) might violate the ABM Treaty.



satellite equipped with a thruster, rather than at a missile rising from Earth.

In other words, although Zenith Star would be space-based and a step toward an ABM laser, the specific experiment resembles a test of an anti-satellite weapon. That, says the Pentagon, is permissible. The Defense Department further argues that Zenith Star does not violate a ban on "ABM-capable" systems because the laser isn't powerful or maneuverable enough to be militarily significant. The Pentagon's formal certification that Zenith Star complies with the treaty states, among other things, that "target vehicles in the high-power laser experiments are not in-flight trajectories having the characteristics of the flight trajectory of a strategic ballistic missile."

Critics claim that the situation isn't so cut and dried. "The Zenith Star experiment would involve a laser bright enough to destroy strategic missiles in flight at long ranges," argues Matthew Bunn, senior research analyst of the Arms Control Association. This is "the minimum needed" to "substitute for an ABM interceptor." In Bunn's view, that means being able to shoot down a single incoming vehicle, which the ABM Treaty prohibits. Bunn also charges that Zenith Star "would involve large-mirror sensors of the type needed to substitute for an ABM radar."

The Lofting Loophole

Another Defense Department argument is that the ABM Treaty permits experiments with ground-based systems. Thus, the Pentagon says it's okay to launch experiments briefly into space if they don't go into orbit.

"We're well within the constraints of the treaty for the next year, maybe longer," remarks Air Force Col. Denis Riva, who heads SDIO's space-based interceptor program. "If we were to orbit an interceptor or a squadron of interceptors, then we'd have treaty issues."

However, Harvard University defense analyst Ashton Carter warns that this "lofting loophole" could backfire. The main U.S. concern, he says, should be ensuring that the treaty's compliance rules prevent experiments that could enable the Soviet Union to rapidly deploy missile defenses of their own.

"We should be asking ourselves:

PHOTOS: DEPARTMENT OF DEFENSE

'What kind of test would make us uncomfortable if the Soviets were to do it?' " he told a congressional committee. "The question for us is whether the lofting loophole is a loophole we want to exploit, in view of the fact that the Soviets might exploit the same loophole someday."

Pentagon officials stand by their reasoning. They say most outside analysts don't have access to classified details—such as a laser's configuration or power—that are crucial to determining whether a device is "ABM capable." Speaking "not for attribution," one official commented, "It's easy to stand on the outside and get sort of a press-coverage level of what a certain experiment is like and then make assumptions about the details."

The same official also dismisses the objection that treaty loopholes could come back to haunt the United States. He thinks "we wouldn't have any provisions of the ABM Treaty to point to" even if the Soviets did use this loophole.

Yet SDI officials clearly find treaty compliance a burden. "We have to configure the tests in a very specific way, [so] that we can't get all the data at one time," Judd complains. But he and his colleagues also insist that SDI tests can legally accomplish their immediate mission—giving the president, Congress, and the public important information on whether a Star Wars system can work. "I personally believe that we can keep SDI so that it's clearly on this side of the ABM Treaty," the official says.

Of course, if the tests succeed and the United States decides to deploy Star Wars, the ABM Treaty's days would be numbered anyway. "The SDI and the ABM Treaty are on a collision course," says Sidney Graybeal, chief scientist at the National Center for Security Negotiations. "It's just a question of when." ■

VINCENT KIERNAN, a former MIT Knight Science Journalism Fellow, covers military issues for Space News.

Red Weather

Despite a decade-long hiatus in missions to Mars, broken only by an abbreviated Soviet *Phobos 2* attempt to provide close-up views of its surface and drop tiny landers on its largest moon, the Red Planet's pull on the human psyche has remained strong. A picture of the planet's climate history is slowly emerging from ground-based observations, new analysis of old data, and studies of Martian meteorites. The results have shifted scientific emphasis from searching for present life to seeking signs of life in the past.

The abortive Soviet mission produced a unique temperature map of the Martian surface before telemetry contact with the craft was lost. With a resolution of about one mile, *Phobos* mapped surface temperatures along the 3,000-mile-long Valles Marineris. By measuring how the ground heats and cools each day, Soviet scientists hope to learn more about the current composition of the soil.

But for clues to the climate long ago, researchers are studying Mars' more salient features—the long sinuous valleys with branching tributaries and rounded valley heads. Although riddled by relatively recent impact craters, the valleys formed during Mars' earliest epochs. They resulted from slow erosion, implying a brief and much warmer period sometime in the distant past.

The warming might have been caused by a greenhouse effect from a dense carbon-dioxide atmosphere. Where the carbon dioxide went is a puzzle, but it might be in water-laid sediments at the valley heads. "Most of Earth's original carbon dioxide now resides in carbonate rocks formed under water," notes Cornell planetologist Steven Squyres. "And the same may be true on Mars."

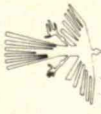
Layered sediments in canyons and valleys near the Martian poles could, like tree rings, record the planet's



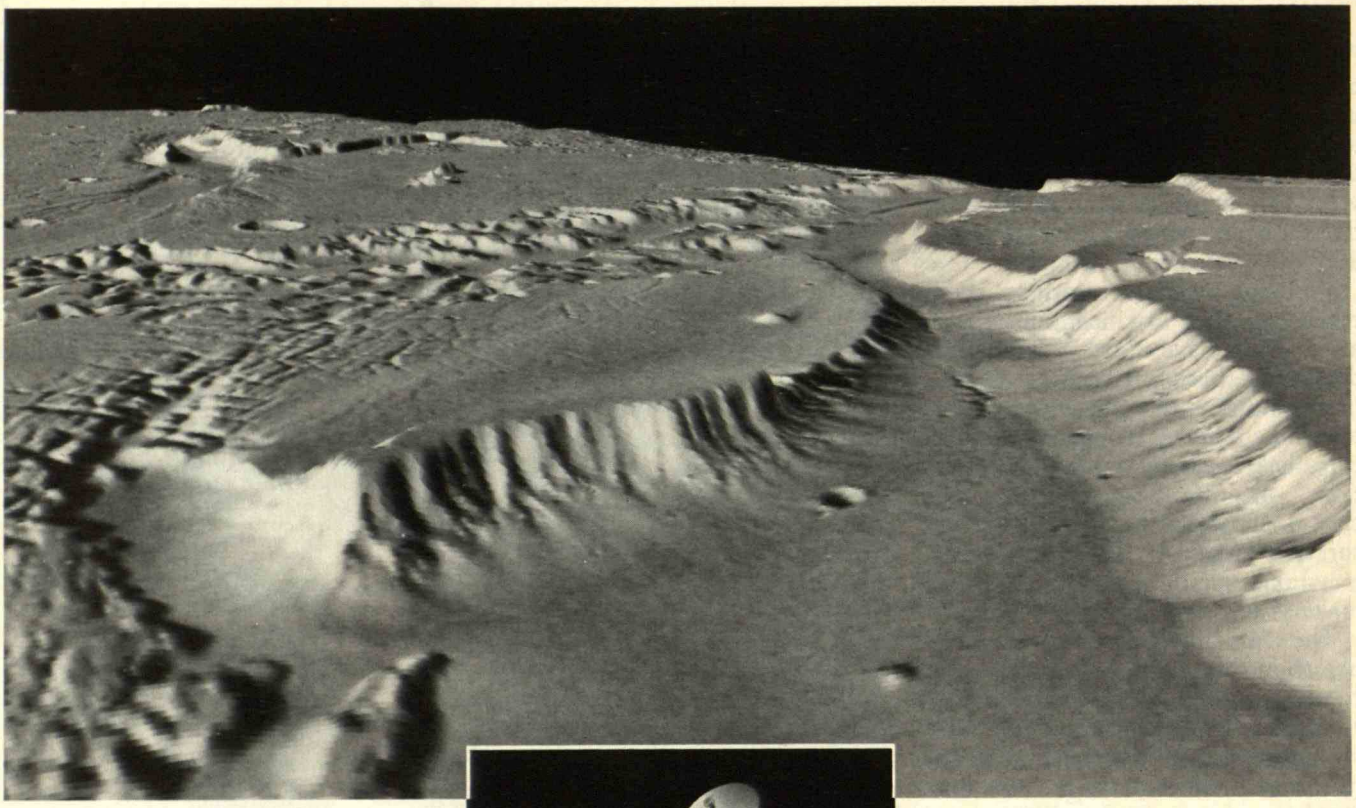
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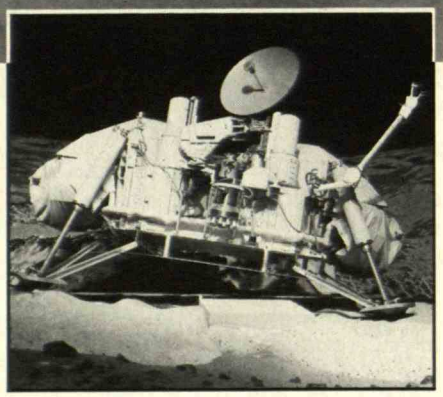
Egypt Greece Asia Minor the Aegean Carthage	*Ancient.*
Central Asia the Kyber Pass India Nepal the Himalayas	*Mysterious.*
Japan Southeast Asia Java Borneo Ceylon	*Oriental.*
Sumatra South America the Galapagos the Amazon Ancient Civilizations	*Enigmatic.* *Primitive.* *Vibrant.*
the Andes Australia New Zealand New Guinea Kenya	*Compelling.*
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Studies of the Kasei Valles, a Martian channel 1,500 miles long and 200 miles across, indicate that the planet once had considerable water. The 1976 Viking *lander (inset) provided such evidence as well.*

more recent climate history. Windblown dust from the equatorial regions has been preserved in the ice there.

The potential for layering continues, and recent Earth-based observations have tied dust storms to short-term meteorological variations. From late 1988 to early 1989, when Mars came closer to the sun than at any other time in a century, a joint amateur-professional International Mars Patrol constantly monitored surface features and the cloud cover.

The watch confirmed that Martian weather is linked to the advance and retreat of the polar caps, which are in turn linked to the planet's distance from the sun. When Mars was closest to the sun, a 40 percent rise in solar radiation shrank the south polar cap to a tiny white patch. But at the same time, heat-generated winds raised great clouds of yellow dust, apparently large enough to block sunlight and slow the polar cap's retreat, according to Jeff Beish and his colleagues in the Association of Lunar and Planetary Observers.

It's a Wet, Wet World

Although Mars is currently a desert, as the 1971 U.S. *Mariner* 9 orbiter and the 1976 *Viking* landers and orbiters have confirmed, even a cursory glance at photographic maps made by these spacecraft provides ample geologic evidence that the planet once had considerable water. The most striking features are "outflow channels"—deep, wide canyons formed during catastrophic floods.

To gauge the intensity of such floods, Mark Robinson of the University of Hawaii and Ken Tanaka of the U.S. Geological Survey have studied *Viking*'s stereographic images of the Kasei Valles, a 1,500-mile-long, 200-mile-wide channel near the Martian equator. This has yielded three-dimensional data on channel slopes and peak flood levels, and Robinson calculates that 1,000-foot-high walls of water once raced down the channel at 100 miles per hour. According to Squyres, flood-gouged channeling could occur even today. If the water burst up from reservoirs deep underground, it would keep "flowing along, fizzing and bubbling like dirty, icy seltzer, for many hundreds of miles

ILLUSTRATION: MARK S. ROBINSON, KEN L. TANAKA; PHOTO: NASA

before it froze."

When scientists tally up how much water would be needed to create the canyons and other features, notes Squyres, "the Mars that emerges is basically a 'wet' planet . . . one that was a lot more Earth-like in its early history than it is now." As climate data paint that picture, scientists have accelerated their search for evidence of former life. The effort got a tentative, if controversial, boost last year when Open University researchers in Milton Keynes, England, examining a five-pound meteorite of possible Martian origin, found a trace of the type of carbon-containing material that is believed to be essential for the emergence of life.

Still, the sample—presumably jarred loose when an asteroid or comet collided with Mars—could have been contaminated by handling on Earth. The carbon-bearing material—calcium carbonate and other yet-to-be-unidentified organic compounds—might even have come from the cosmic cue ball that knocked the rock free. Confirmation of the carbon's origin awaits future expeditions.

And exploration is set to resume. In 1992, the United States plans to launch a two-year *Mars Observer* mission to conduct experiments from an orbit 200 miles up. Gamma-ray and thermal spectrometers will determine surface composition and a laser altimeter will measure elevations.

In 1994, the Soviet Union hopes to send two orbiter-rover combinations to Mars. During their slow descent, balloon-borne instruments will transmit detailed images to Earth, possibly via the U.S. craft. After touchdown, rovers will amble hundreds of miles over the landscape for a year, sampling soil and blazing trails for future vehicles. ■

JAMES CORNELL edited Bubbles, Voids, and Bumps in Time *(Cambridge University Press, 1989), a collection of essays on modern cosmology.*

Sandbox Scholars

Children discover the properties of sand by scooping it up in buckets, dumping it on the ground, and stomping on the piles. Scientists are going through similar exercises to learn about the flow of granular material—and possibly to fathom such diverse events as earthquakes, landslides, forest fires, epidemics, and stock-market crashes.

Previously the domain of mechanical and structural engineers, sand has caught on with physicists and mathematicians. The substance is unusual because it combines qualities of both liquids and solids. Like a liquid, sand can flow, yet it forms piles like a solid.

Among the first to conduct research on the subject was the eighteenth-century French scientist Charles Coulomb, who wanted to understand why sandpiles are stable. Recent research has been spurred, in part, by interest in large-scale phenomena, such as turbulence and chaos. In a 1987 paper, Per Bak, Chao Tang, and Kurt Wiesenfeld of Brookhaven National Laboratory suggest that the behavior of sandpiles may represent a general phenomenon in systems with many interacting parts.

The Brookhaven researchers dub this behavior "self-organized criticality." In the case of sand, if you slowly add grains to a pile, it will steepen until it reaches a "critical" slope. Add one more grain, and a chain reaction occurs, the outcome of which is unpredictable. There may be a tiny sandslide or a giant avalanche, but either way, the pile will remain at the critical angle. "Avalanches are a way to remove excess sand so that the angle remains the same," Bak says. The system is self-organized because, when sand is added, it automatically goes to this critical state and stays there during and after avalanches.

Bak notes that he's "not interested in sandpiles per se. I'm more interested in earthquakes." According to Bak, the greatest success of the Brookhaven model has been in understanding movements of the earth's crust. Current theory holds that the crust is

By studying how sand flows through hoppers, scientists are gaining insight into events such as earthquakes, epidemics, and the October 1987 stock market crash.



PHOTO: UPI/BETTMANN NEWSPHOTOS



Leo Kadanoff (left), Sidney Nagel, and other Brookhaven researchers compare computer-generated avalanches with those in a sandpile in their laboratory.

divided into contiguous, moving plates. Pressure mounts as two plates grind against each other, just as the slope of the sandpile increases with added grains. When the pressure exceeds a critical value, an earthquake will occur. However, the theory can't predict when and where it will occur. In fact, says Bak, the theory is "a way of explaining why such events are inherently unpredictable" because small variations in the condition of the earth's crust can cause wildly different outcomes.

The Brookhaven physicists base their theory solely on mathematical models, so University of Chicago physicists Heinrich Jaeger, Chu-heng Liu, and Sidney Nagel decided to try it with real sand. While the empirical test didn't refute the general idea, it painted a more complicated picture than expected. Instead of just one critical angle, sandpiles oscillate between one at which avalanches occur—the "angle of maximum stability"—and another to which a system reverts after an avalanche—"the angle of repose."

"We think we know how sand behaves, because we've all played with it as kids," Nagel observes. "But if you look at sand closely, you find it works in subtle ways. It's a tricky beast."

Stocks and Fires

Like Bak, Nagel had no particular curiosity about sandpiles when he got into the field. He just thought they might provide insight into other complex phenomena, such as earthquakes and epidemics. An epidemic, for example, might reach a critical point: infecting one more individual could cause the disease to diffuse in myriad ways. Forest fires may spread in a similar fashion. At the critical state, igniting one additional tree would be akin to adding a grain to a sandpile poised at the threshold.

Self-organized criticality may even explain why the stock market is unpredictable. The economy—with its multitude of interacting players—might get pumped up to a critical state. "Small perturbations can then give rise to avalanches like a crash of the stock market," Bak says.

While such speculation is intriguing, does the world really organize itself in this fashion? "The evidence isn't in yet," notes University of Chicago physicist Leo Kadanoff. But even if the theory turns out wrong, sandpile research has immediate applications—such as explaining the behavior of granular materials used in industry.

Food grains, coal, sand, salt, gravel, and pharmaceutical powders are commonly stored in silos. Sometimes these silos plug up, preventing material from falling out at the right time. In other instances, vibrations in the flowing material can shake a silo to pieces. With a hospital x-ray machine, a Duke University team has studied the flow of sand from a hopper. They have discovered "density waves"—distinct bands of tightly and loosely packed particles—moving through the streams of flowing sand.

"It's likely that you get these kinds of waves in silos all the time," explains Duke physicist Robert Behringer. "It's also reasonable to guess that the waves are related to vibrations that can cause the structures to fall apart." Lab experiments are now under way at Duke to find out why the waves form and what affects their propagation. "But at this point," Behringer says, "we don't have any way of predicting the waves theoretically or knowing what they mean practically."

By studying the controlled flow of sand through a hopper, Duke scientists also hope to understand more complicated flows, such as landslides and mountain avalanches. So far, Behringer observes, "avalanches are about as well understood as all granular flows, which is not very well." ■

STEVE NADIS is a frequent contributor to Trends.

PHOTO: ROBIN B. JESHION

Biocomputing

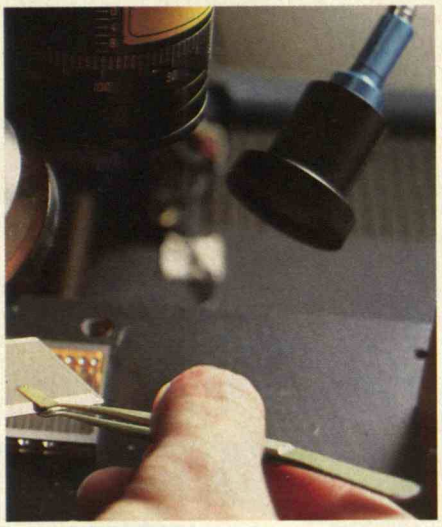
Computer chips with molecule-sized circuits made from the building blocks of life are the stuff of scientific fantasy. Yet reality has matched part of the dream as microprocessors have shrunk to the size of a stamp. Now scientists are tackling the rest of the job with electronic switches and transistors made from organic molecules.

"We're looking beyond [the conventional] to very sophisticated machines that will try to tap into the potential of biomaterial," says Felix Hong, a medical researcher at Wayne State University. Circuits made of biological materials may lead to "molecular computers" that can learn the way people do. According to Robert Birge, director of Syracuse University's Center for Molecular Electronics, one advantage of protein switches is that they are more than a thousand times faster than those made from semiconductors such as silicon or gallium.

Most efforts to merge biomaterials and computers build on the principles underlying biosensors. These devices are coated with enzymes, antibodies, or antigens that can reveal the presence of certain important biological agents—such as glucose, lactate, or some electrolytes—because a chemical reaction occurs when the two substances meet.

Taking biosensors a long step further, Syracuse University researchers have used a bacteria protein that closely resembles eye pigment to create a novel computer processor. In this "optical computer," light takes the place of electrical currents in the computer switches that handle information. Birge says that "the protein switches so fast we can't make use of its speed yet."

The protein, which is applied in layers one molecule thick on a quartz plate, can store and retrieve visual images such as trees or faces. According to Birge, this device can "recall a complete image if you give it only part of an image." It does so by making "an association between a small bit of information and the whole package, just the way the brain works." Soviet scientists have also created optical devices made of biomaterials, as have scientists at Sharp, Sanyo, and others in Japan.



Biosensors, which might be implanted in a machine or a human being, are a step toward computers that can see and smell.

Carbon-Based Machines

The Japanese firms are part of the best organized and funded effort to design computers that mimic the way a brain works. Nearly 100 researchers at eight corporations and the Electrotechnical Laboratory (ETL) in Tsukuba Science City are three years into this ambitious ten-year venture, which aims to devise components that can "see" and "smell."

Because proteins in humans sense light, odors, temperature, or textures, computer circuits incorporating proteins should be able to react to such sensory data as well. This property would help biomaterials recognize patterns, a task conventional computers perform poorly. Thus, proteins or other biomaterials could lead to a practical alternative to silicon circuits. Wayne State computer scientist Michael Conrad believes that the project could yield new computing products by the end of the century.

At the same time, an ETL group led by Gen Matsumoto is studying rats to discover more about what happens inside brains when learning takes place. The goal is a computer operating system that replicates the way brains process information, which would eventually lead to "neural network" computers.

In essence, explains Matsumoto, the ETL research would marry bioelectronics and neural networks. The resulting generation of computers should be able to rapidly process large amounts of varied information, from textures to images and language.

However, such applications are still a long way off. For example, biomaterial components are quite fragile and difficult to work with. Among other problems, biomaterials must be kept very cold to lessen electrical noise. Thus, Matsumoto says, the components would form only "the sensory part of the computers." These pre-processors—the eyes and nose of a computer—would transfer that information to a conventional semiconductor central processor.

Tailored molecules—like genetically engineered drugs—may one day overcome some handling problems. But Michio Sugi, ETL section head of molecular electronics, cautions that "10 years is too short" when the task is designing molecules for specific engineering needs.

Even so, the potential is enormous as researchers move toward "a so-called carbon-based machine, rather than a silicon-based machine," says Wayne State's Hong. "That opens up a whole new dimension so rich we are just beginning to scratch the surface." ■

TOM KIELY is a staff writer at New England Business *and a regular contributor to Trends.*

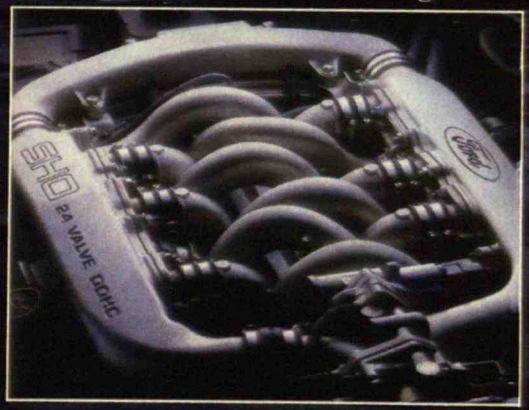
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Our northern neighbors have discovered how to give adequate care to their entire population, but a Canadian-style system in the United States would have to control costs and promote health better.

Lessons from Canada's Health Program

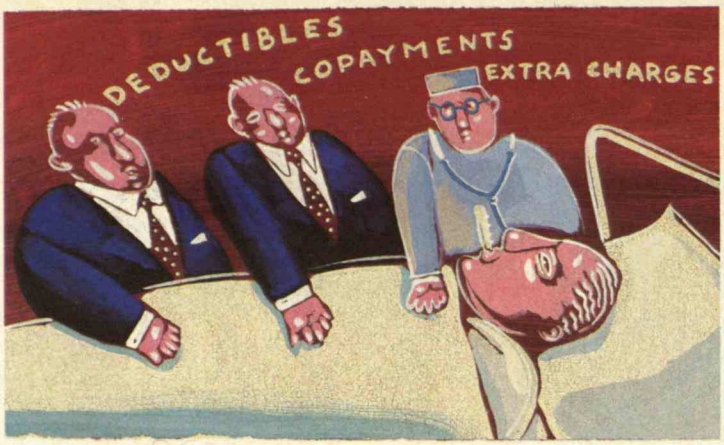
BY MILTON TERRIS

IN 1965, Congress decided to solve once and for all the problem of assuring adequate health care for all U.S. citizens. It established Medicare, a federal health-insurance program for the aged financed through Social Security; and Medicaid, a federal-state program for the indigent and "medically indigent." The rest of the population, lawmakers reasoned, could rely on voluntary health insurance.

A quarter of a century later, total health expenditures have shot from 6 percent of gross national product to more than 11 percent—well over $500 billion a year—throwing the nation's health-care system into disarray. Medicare now covers only 40 percent of the health costs of the aged. The states have slashed Medicaid. And 37 million Americans have no insurance whatsoever, while many more millions have too little. Not surprisingly, a 1988 Harris poll showed that 89 percent of Americans think the system is in sad shape.

Meanwhile, north of the border, in a country very similar to our own, citizens are so happy with their medical-care system that no government would dare take it away. Canada's national program, adopted in 1961 for hospital care and in 1971 for physicians' services, covers the entire population. Although eyeglasses, outpatient prescription drugs, dental care, and nursing home charges are not part of this universal program, they are covered in whole or in part by some of the provinces. Federal and provincial taxes pay for over 95 percent of the country's hospital and physician costs; the remaining costs are hospital charges for amenities such as private or semiprivate rooms and physician charges for cosmetic surgery. As in the United States, patients have free choice of physicians, but more Canadian doctors are in solo practice, and more Canadian hospitals are nonprofit.

ILLUSTRATIONS: EUGENE YELCHIN



Unlike Canadians, Americans who have paid health-insurance premiums are saddled with further costs at the time of illness.

As the U.S. medical-care crisis deepens, Canada's health system is looking more and more attractive to Americans. The 1988 Harris poll found that 61 percent of Americans prefer it to their own system. Countless individuals and groups, including Sen. Edward Kennedy, a delegation from the Gray Panthers, and numerous health professionals, have trekked to Canada for a firsthand look at the medical system. Many have come away convinced that setting up a similar system in the United States would ease the twin problems of rising costs and increasingly inequitable health coverage.

These observers are only half right. Adopting such features as universal coverage, payment in full, and funding through progressive taxes would give people of all incomes equal access to medical care. But a Canadian-style system would do little to control U.S. health expenditures.

Although medical fees are set by the provincial governments, most Canadian doctors, like their U.S. colleagues, are paid on a fee-for-service basis: the more procedures they perform, the higher their income. In both countries, this practice encourages doctors to perform unnecessary services and drives up health spending. Any new U.S. health system that kept the fee-for-service approach intact—as set forth in Sen. Kennedy's mandated-care bill, in a Canadian-influenced plan by Physicians for a National Health Program, and in almost every other proposal—would perpetuate these problems.

Beyond a doubt, the Canadian medical-care system can teach the United States a lot about how to provide fair and humane health coverage. But in seeking solutions to the nation's medical woes, Americans must be prepared to learn from Canada's weaknesses, as well as its strengths.

MILTON TERRIS, M.D., M.P.H., is editor of the Journal of Public Health Policy *and president of the National Association for Public Health Policy. He is also a visiting professor in the Department of Preventive Medicine and Biostatistics at the University of Toronto's Faculty of Medicine and in the University of Montreal's Department of Social and Preventive Medicine. He has been studying Canada's approach to medicine since the 1940s.*

Strong Medicine

One of the best things about the Canadian health system is that it is funded mainly through progressivetaxes—that is, taxes that increase with income. In contrast, health-care funding in the United States is essentially regressive, in that it hits lower-income groups the hardest. Voluntary health-insurance premiums are the same for everybody, regardless of income. And Social Security deductions for Medicare are based on income only up to a certain ceiling; beyond that, everyone pays the same amount.

Taking a cue from Canada, the United States could fund medical care much more equitably than at present through progressive, graduated income taxes and corporate taxes, as well as excise taxes ("health taxes," not "sin taxes") on tobacco, alcohol, firearms, toxic chemicals, and other hazardous products. This tax structure would distribute most of the burden of costs according to people's ability to pay. And by discouraging the use of hazardous products, it would lessen the need for medical care and thus cut health-care costs.

Another way the Canadian system manages to embrace the entire population is by paying for services in full. In the United States, people who have paid premiums on voluntary or governmental insurance are saddled with further costs, often quite extensive, at the time of illness. These include deductibles and copayments, as well as extra charges from physicians who are not satisfied with the amounts they receive from insurers. Canadian consumers carry no such burden, and neither should Americans.

Canada also has lower administrative costs. In 1985 these amounted to 1.3 percent of total health expenditures, versus 5.6 percent for the United States. The U.S. medical system has a multiplicity of private insurance companies incurring enrollment costs, maintaining reserves, and skimming off profits. Even Medicare, a U.S. government program, is administered by private insurance companies at the state and local level.

In Canada's national plan, private insurance companies play no role. Instead, the program is administered by the health department or another

government agency in each of Canada's ten provinces and two territories. The federal government pays a quarter of the costs, so long as each provincial program offers universal coverage on uniform terms, pays for care received anywhere in Canada, includes all medically necessary services, and is publicly administered.

The United States, like Canada, should avoid setting up a single federal system. Instead, public health departments in each state could submit plans to the Department of Health and Human Services that meet basic federal requirements but are tailored to local health needs. This form of administration would be less diffuse, and therefore more efficient, than today's U.S. practice. At the same time, it would be decentralized enough to allow each state some flexibility.

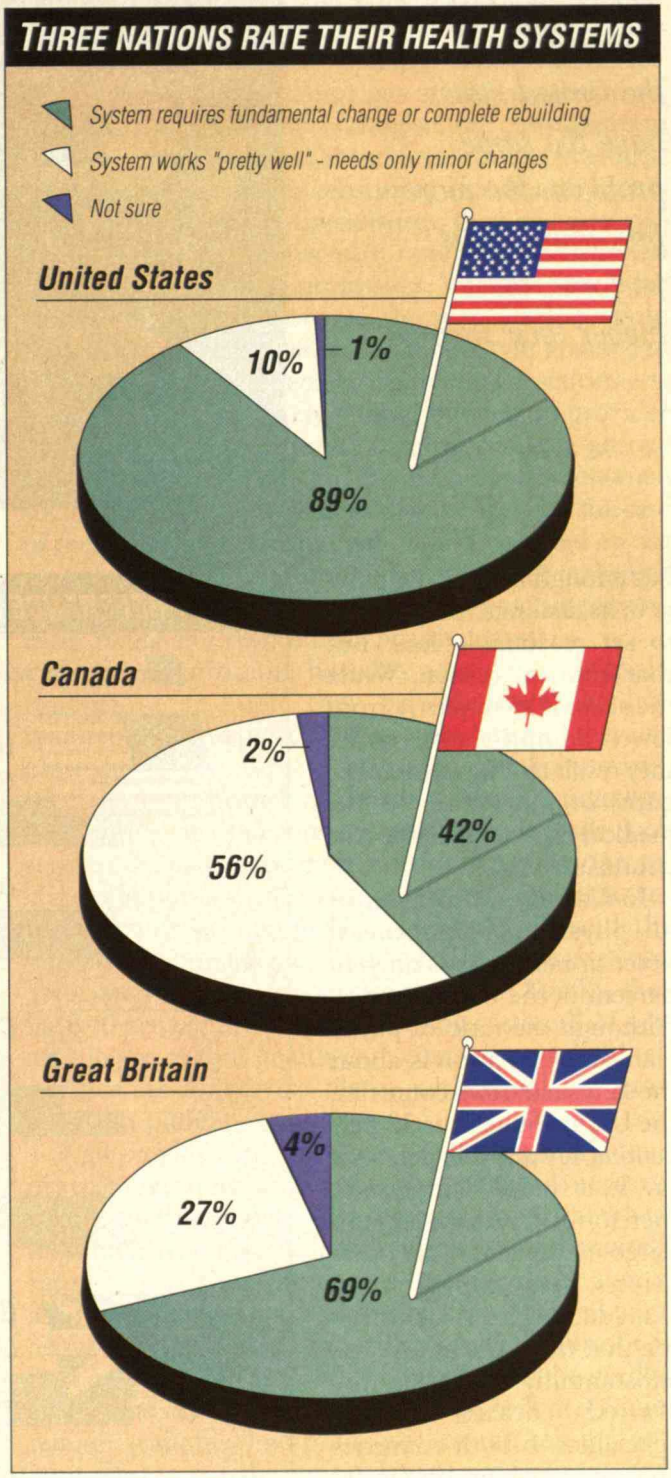
Canada's decentralized approach gives provinces the latitude to experiment with various ways of organizing and improving health services. Quebec, for example, has developed a network of 155 innovative community service centers where salaried personnel provide both health care and social services. And the Ontario Ministry of Health has helped set up a growing number of alternative health-care centers that provide comprehensive care economically. These include both community health centers where physicians are on salary, and health service organizations where physicians are paid according to the number of patients enrolled.

Bitter Pills

Unfortunately, those efficient organizations are more the exception than the rule. The basic weakness of the Canadian program, and also of U.S. health care, is that it is "doctor-driven." Physicians—the ones who decide the number and types of services to provide, as well as whether patients should be hospitalized or operated on—generally receive fee-for-service payment instead of a salary. Thus, in Canada, a major portion of each provincial budget is determined not by the provincial government but by the medical profession.

Americans who advocate importing Canada's health system wholesale are willing to overlook the pitfalls of fee-for-service because Canada seems able to control costs in spite of it. Health expenditures are lower in Canada than in the United States. In 1986 they amounted to about $1,370 per person, versus $1,930 in the United States. Health spending accounted for 8.6 percent of GNP in Canada, versus 11.1 percent in the United States. The rate of increase in per capita costs has been lower as well—3.1 percent a year in Canada and 4.8 percent in the United States.

The most popular explanation for Canada's lower costs is that the government agency in each province



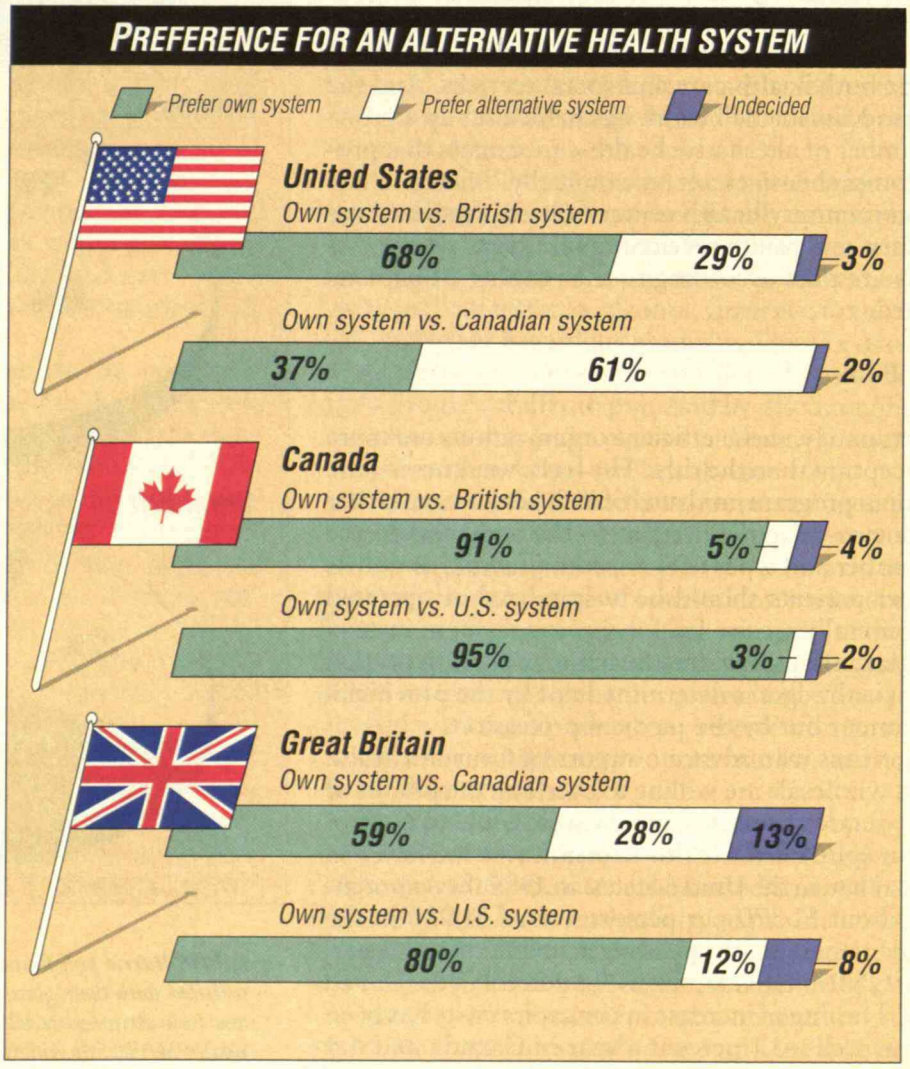
A 1988 Harris poll found that Canadians are much more satisfied with their government-funded medical-care system than Britons are with their government-run National Health Service, or Americans are with their combination of public and private health insurance.

Canada and the United States have the same problem: the more procedures MDs perform, the higher their income.



has enough bargaining power in its dealings with doctors to set reasonable fees. But that's not the reason. While the savings stem partly from lower administrative costs, they result mainly from differences in the nature of the medical profession in the two countries.

In Canada, 50 percent of all physicians are general practitioners, versus only 10 percent in the United States. Although the ratio of physicians to population is about the same in the two countries, the United States has 33 percent more surgeons per capita. It is hardly surprising, therefore, that Americans undergo 40 percent more operations per capita than Canadians. Nor is it surprising that the costs of care are substantially higher in the United States. First, specialists in both countries charge considerably more than general practitioners; U.S. specialists often pull in $130,000 to a quarter of a million a year, GPs only about $80,000. Second, specialists are trained to use expensive high-tech diagnostic and



According to the 1988 Harris poll, a majority of Americans would trade their own health system for Canada's. The British aren't so sure. Few Canadians or Britons prefer the U.S. system.

therapeutic procedures, whether or not these make a significant difference in the patient's health.

Provincial attempts to control health budgets by restricting doctors' fees have failed. From 1972 to 1984, the provinces cut fees by 18 percent in real terms, but by an amazing coincidence, doctors' total billing claims rose by 17 percent. Similarly, when Quebec froze doctors' fees in the early 1970s, and their real-dollar value dropped 9 percent from 1972 to 1976, doctors increased their billings by almost the same amount, 8.3 percent. Alberta froze medical fees in 1984, but doctors upped their gross incomes that year by more than 12 percent. Hit with a fee cut, doctors simply see more patients and provide more services.

In the United States, efforts to control the excesses of fee-for-service have been even more disheartening. From 1982 to 1987, physicians' total charges for Medicare patients rose by 76 percent, from $15.1 billion to $26.6 billion. Doctors attribute this rise to better, more expensive technology, the aging of the population, and consumer demands. But did technology improve by 76 percent in five years? Did the older population expand by 76 percent? Did consumers' appetites for care grow by 76 percent? More likely, physicians' appetites for ever higher incomes were responsible.

With fee-for-service payment, doctors often perform tests, procedures, and surgical operations without regard to medical necessity. The wholesale removal of children's tonsils is a procedure without any scientific validity. Yet one study found that tonsillectomies were performed on 107 of every 10,000 people per year in British Columbia and on 200 per 10,000 in Ontario. In Liverpool, England, and Uppsala, Sweden, where surgeons are all on salary, the rates were 26 and 17 per 10,000. Caesarian sections in Canada have skyrocketed from fewer than 5 percent of births in 1968 to about 20 percent today—second only to the U.S. rate of over 25 percent. As a World Health Organization expert committee has pointed out, "Countries with some of the lowest perinatal mortality rates in the world have caesarian section rates of less than 10 percent. There is no justification for any region to have a rate higher than 10 to 15 percent."

Canadian physicians have also used their political clout to shut out other health professionals who threaten their control of the medical marketplace. They have prevented legalization of midwives; Ontario is the only province where midwives are winning official recognition. And nurse practitioners are almost unknown in Canada. The political pressures brought to bear by the medical profession killed the nurse-practitioner movement, which promised effective care at lower cost.

Similarly, the medical profession has severely limited the development of community health centers that employ salaried physicians. It has used a variety of tactics: pressuring politicians, ostracizing health-center physicians, prevailing on hospitals to refuse them hospital privileges, waging campaigns of misrepresentation, refusing to permit anesthesiologists and consultants to serve the centers, and other ruthless business practices.

If a major reason for reforming U.S. health care is to stem rising health expenditures, then any new system in the United States must remove costs from the control of the medical profession. The best way is for the state health departments, the agencies that would administer funds under a Canadian-style system, to make no payments directly to individual practitioners. Instead, they should pay annual budgets to provider organizations—community health centers, group-practice organizations, and the individual-practice associations sponsored by medical societies—for the care of their enrollees. The budgets would be based on the cost of providing care through the most efficient health organizations around: salaried group-practice prepayment plans and community health centers.

These organizations have key advantages over solo practitioners. First, they provide more health-maintenance and preventive services. Second, they improve the quality of care by bringing general physicians, specialists, and other health professionals together; community health centers in particular include such services as health education, nutrition, psychology, social work, physical and occupational therapy, and community outreach programs. Third, they avoid the paperwork, bureaucracy, and high administrative costs associated with fee-for-service payment. Finally, they have 40 percent lower hospitalization costs and 25 percent lower overall health-care costs than individual-practice fee-for-service plans, with equal or better results in patients' health.

If all provider organizations—including individual-practice associations that pay practitioners on a fee-for-service basis—were forced to stay within these reasonable budgets, a drop in unnecessary hospitalizations, operations, and procedures would be sure to follow. Reducing unnecessary medical care in this manner would slash today's half-trillion-dollar health outlay by a quarter. The $125 billion saved could be used to ensure that necessary and effective high-tech procedures remain available, and to include dental, mental, and long-term care in the national program. Savings in administrative costs would provide further billions of dollars for needed services.

Provider organizations should be classified as public utilities under state and federal laws. As such, their budgets, minutes of board meetings, and all administrative and service procedures would be open to public scrutiny. And their profits would be regulated by the

state health department responsible for administering the program.

A Question of Quality

A shift to annual budgets would address a major defect of a Canadian-style health system by controlling the quantity of care provided. But another basic fault of the Canadian program is that it fails to monitor the *quality* of care. This is not peculiar to Canada. Most medical programs in the United States—Medicare and Medicaid, as well as private insurance—are merely financial, limited to paying for care.

To raise the quality and effectiveness of care, and to help equalize the services provided across the nation, federal standards are essential to a new U.S. health system. These standards should be developed by the U.S. Department of Health and Human Services in consultation with the state and local health departments that administer the programs.



The Canadian program assures equity in health care, but not in health. On average, the poor live only 55 years free from disability; the rich, 66.

To ensure that the standards are followed, public-health officials would evaluate each provider organization. They would assess the qualifications of health personnel, not only by checking their educational background and licensing but also by field-testing their knowledge and performance. Officials would also make sure that providers offered suitable facilities and services.

Statistical analysis would be a major part of this quality-control effort. For each provider organization, health officials would analyze the numbers and types of visits, diagnoses, clinical and laboratory procedures, hospital admissions, and length of stay. More important, they would look at data on the effectiveness of care. They would examine how well providers were reducing risk factors such as high blood pressure and cholesterol levels, eliminating preventable diseases, avoiding problems such as drug reactions and hospital-acquired infections, cutting the number of deaths and the severity of illness and disability, and rehabilitating patients to physical, social, and vocational function. To supplement the statistical analyses, qualified investigators would study samples of patient records to make sure the care is appropriate and adequate.

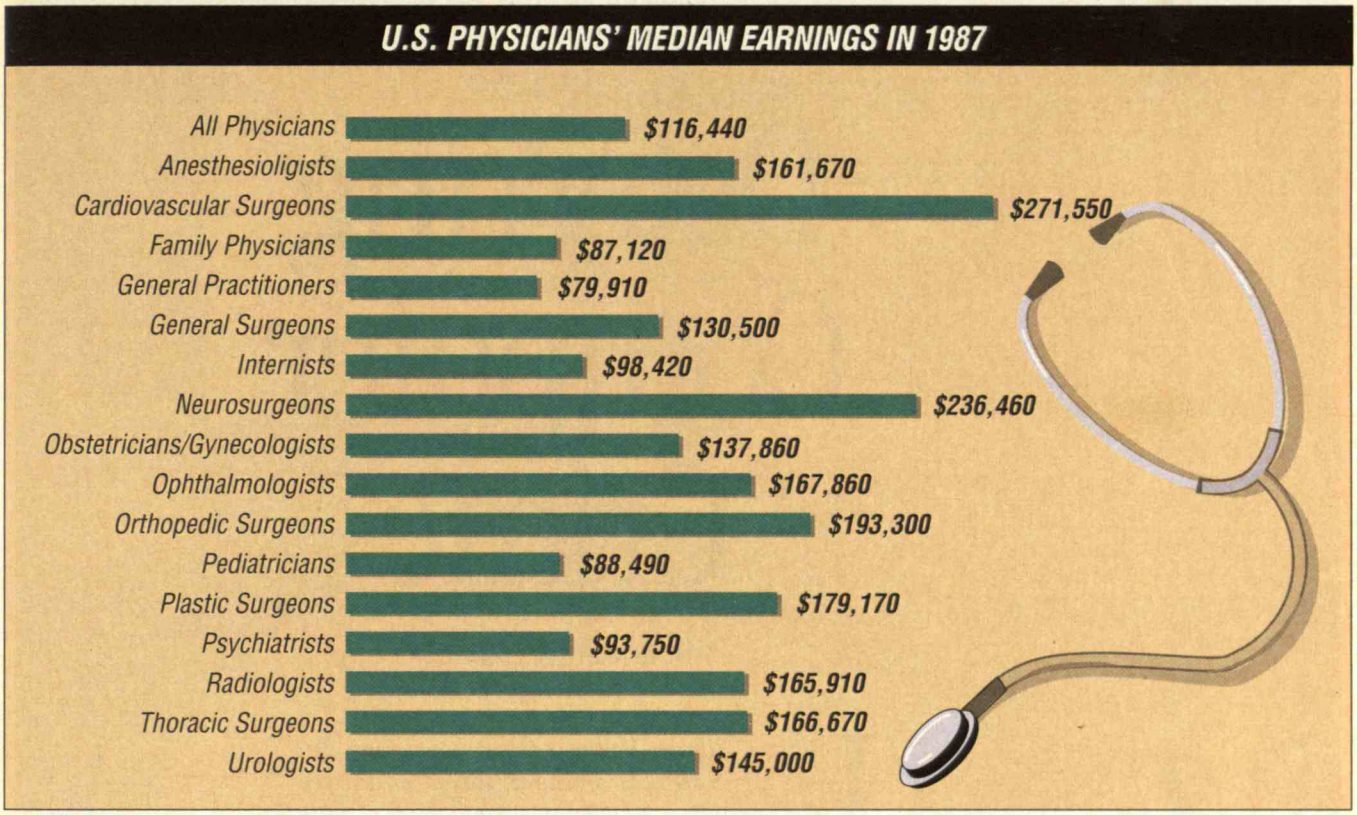
If these investigations uncovered deficiencies, the government could offer consultation, training, or other assistance to remedy them. Gross deficiencies and outright abuses would require appropriate regulatory action to reduce the hazards to patients.

Toward a Healthy Society

Perhaps the biggest failing of the Canadian program is a defect it shares with most of the world's developed nations: its enormous expenditures for medical care have left very little money for preventing disease and injury. This was recognized as long ago as 1974 by the Canadian Minister of National Health and Welfare, Marc Lalonde. He wrote that because society neglects health factors such as environment and lifestyles, "vast sums are being spent treating disease that could have been prevented in the first place."

Illness and death from lung cancer continue to rise in Canada—at an alarming pace in women, for whom the death rate doubled from 1970 to 1979. Chronic obstructive lung disease, another major killer caused mainly by cigarette smoking, is also on the rise in Canadian women. Cirrhosis of the liver, primarily from heavy drinking, increased by 31 percent in men and 21 percent in women during the 1970s. Although deaths from accidents, poisoning, suicide, and homicide declined slightly during this period, they continue at a high level. All these problems are preventable, but even now, 15 years after the Lalonde Report, decisive action has yet to be taken.

The United States is ahead of Canada in promoting public health. The U.S. Public Health Service developed specific national health objectives for 1990, including reductions in death and sickness from both infectious and noninfectious diseases, as well as from injuries. And it is now drafting objectives for the year 2000. Nevertheless, only 2.9 percent of U.S. health spending is for government public-health activities. Considering the primacy of a healthful environment and lifestyle in preventing disease and cutting medical expenditures, this figure is unreasonably low. Public-health spending should be doubled to 6 percent, or roughly $30 billion.



The high fees charged by specialists relative to general practitioners are a key reason that the U.S. has a bigger medical bill than Canada. Specialists earn high incomes in Canada as well—but the U.S. has a lot more of them. Only 10 percent of U.S. doctors are GPs, versus 50 percent of Canadian.

One of the alarming aspects of the current situation, in both Canada and the United States, is the widening gap between rich and poor in preventing disease. Canadians are learning the painful lesson that their medical program assures equity in health care, but not in health. Studies have shown that in the late 1970s, the wealthiest fifth of Canadians lived 4.5 years longer than the poorest fifth and avoided disability 11 years longer. Poor people in Canada have, on the average, only 55 years of disability-free life, while rich Canadians have 66 years.

Such studies make it clear that the most important determinant of health—in the United States, Canada, and every other country—is the standard of living. Poor nutrition lowers resistance to many diseases. Illiteracy is a serious obstacle to learning about preventive measures such as personal hygiene, immunization, and lifestyle changes. Poor working conditions cause many preventable diseases and injuries. Poverty produces low self-esteem, mental dysfunction, alcoholism, drug addiction, and violence against self, family, and community.

During the 1980s, poverty increased in the United States. Although unemployment dropped slightly from 7.1 to 7.0 percent between 1977 and 1986, the poverty rate rose from 11.6 to 13.6 percent, and the number of persons in poverty rose from 24,720,000 to 32,370,000. Hunger reappeared in the 1980s; the Physician Task Force on Hunger in America reported in 1985 that some 20 million Americans experience hunger at least some days every month. Clearly, this decline in living standards needs to be reversed if the United States is to become a healthy nation.

If the concern is with assuring not only equity in medical care, but also equity in health, the Canadian experience has taught us that a national medical-care system is only one element in a total national health program. Nevertheless, it does play a significant role in combating pain and disability and improving the health of the population. Canada has demonstrated the feasibility of assuring medical care for all through a government program financed by progressive taxation. That the program has its flaws should not deter the United States from weeding out the worst features and allowing the best to flourish. How well this country learns from the Canadian experience could profoundly affect Americans' future health—both physical and economic. ■

CHARTS: DEB PERUGI DESIGN

Deterring Computer Crime

By Kenneth Rosenblatt

Traditional law enforcement can't curb electronic theft and vandalism. We need specialized cops and carefully tailored penalties.

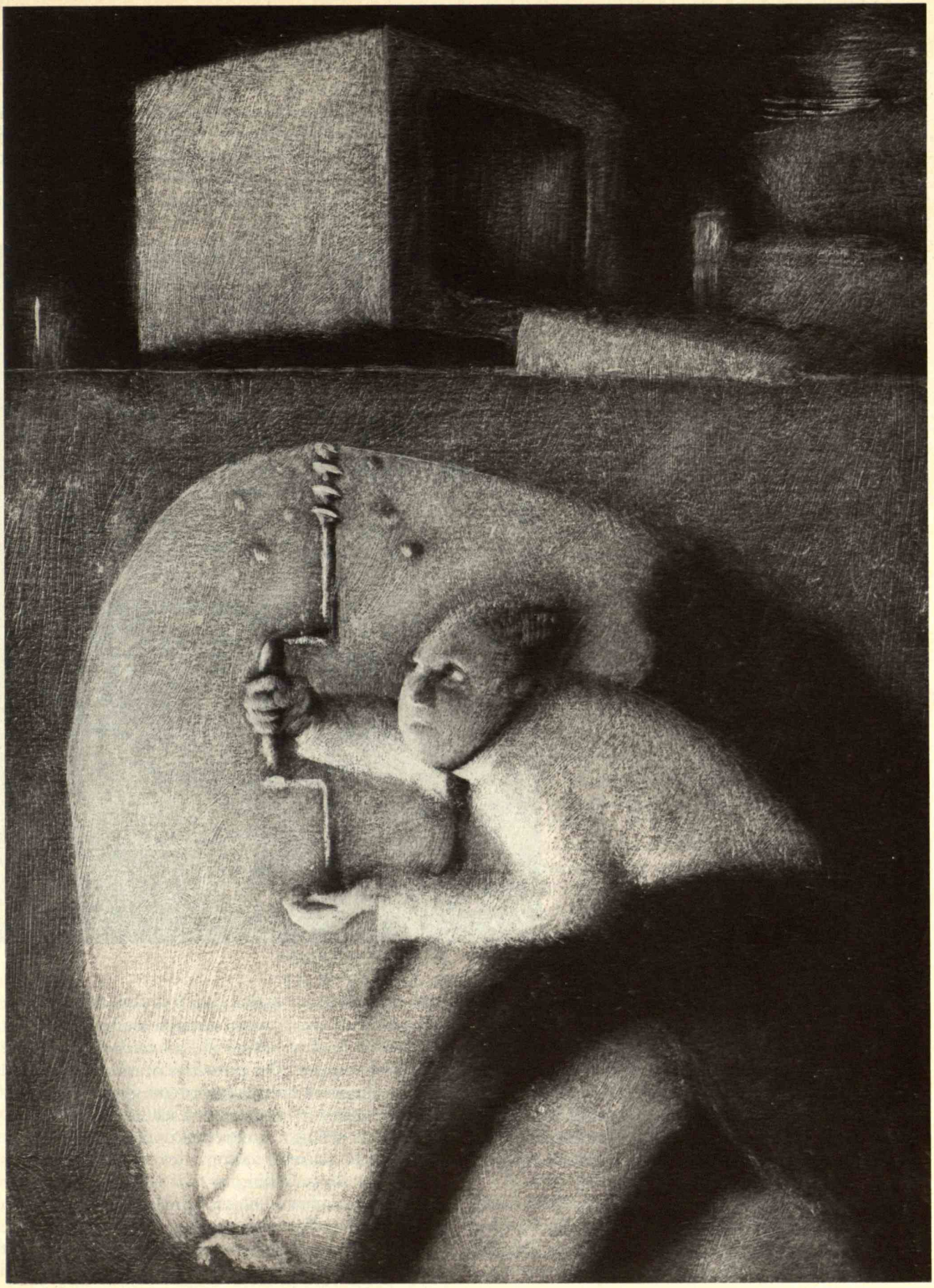
ITEM: *A Silicon Valley software company discovered in 1988 that a recently fired employee was using her telephone to enter its computer system. Before she was apprehended, she had copied several million dollars' worth of the company's products. It is suspected that she had intended to send the software to the Far East.*

ITEM: *A Florida news editor who had moved from one television station to another was arrested in the spring of 1989 for allegedly entering his former employer's computer and copying confidential news stories.*

ITEM: *A group of young "hackers" were recently arrested in West Germany on charges that they had been paid by the Soviet Union to break into NATO computers.*

Though not as celebrated as the case of Robert Morris, the Cornell University graduate student charged with unleashing a "virus" over a nationwide data network, each of these instances reflects the same growing problem: computer crime. Offenses such as altering computer records to obtain money, stealing proprietary information stored on computers, destroying valuable data, and illegally copying commercial software exact a heavy cost for U.S. business. Ultimately, the cost is borne by consumers through higher prices. Although companies' reluctance to report breaches of security makes the losses hard to measure, a rough estimate by the accounting firm of Ernst & Young puts the cost of computer crime at between $3 billion and $5 billion a year.

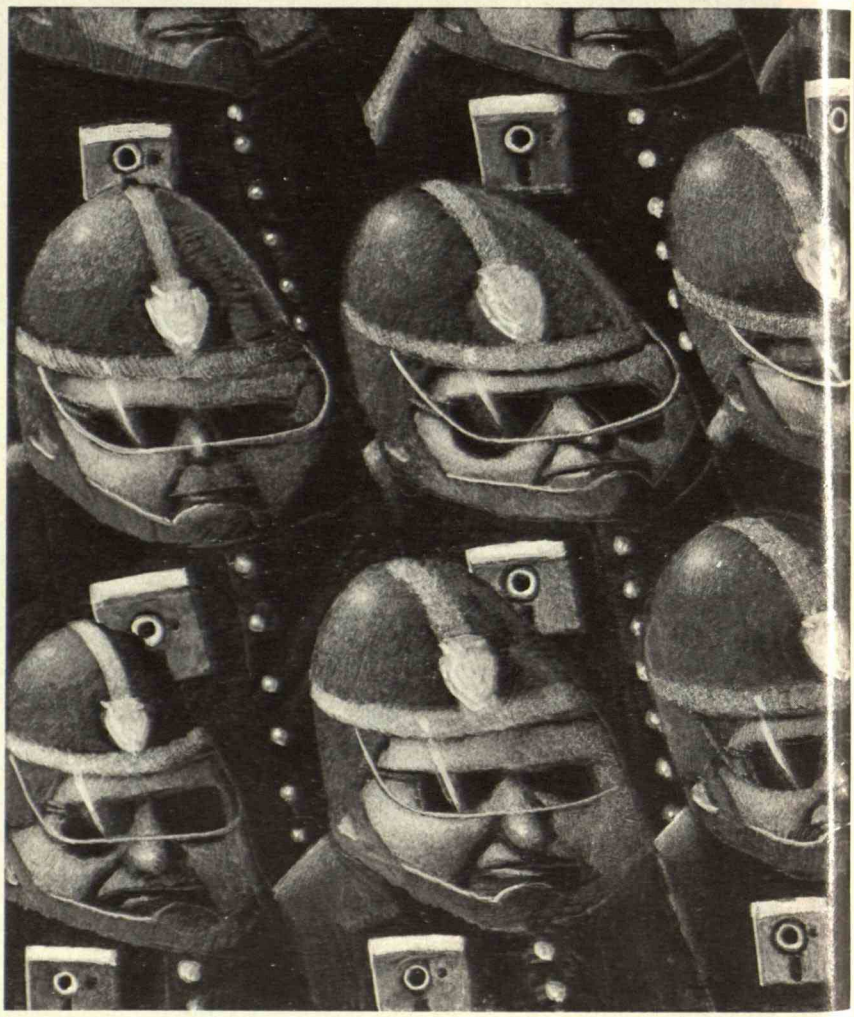
ILLUSTRATIONS: KEVIN HAWKES



And that may be just the beginning. Our society is about to feel the impact of the first generation of children who have grown up using computers. The increasing sophistication of hackers suggests that computer crime will soar, as members of this new generation are tempted to commit more serious offenses. Besides raising prices, computer crime endangers our country's telecommunications systems, since phone-company switching computers are vulnerable to sabotage. The spread of scientific knowledge is also at risk; to prevent "viral" infections, research institutions may have to tighten access to their computer networks.

That computers have become tools for antisocial behavior is hardly surprising. What is surprising about computer crime is how little is being done to deter it: industry will not beef up security, the police are not equipped to catch electronic thieves, and judges do not hand down the kind of sentences that will impress would-be computer criminals.

New strategies are urgently needed. The first step is to abandon the idea that local police departments can fight computer crime effectively. Instead, high-technology regions need special task forces whose sole purpose is to apprehend computer criminals. The second step is to fit the punishment to the crime. Although the most severe offenders should be sent to prison, there are more innovative and less costly ways to give typical computer abusers their due. Together, these steps will deter serious criminals and, more important, discourage similarly inclined teenagers from joining their ranks.



Why Traditional Approaches Do Not Work

The first line of defense against computer crime—system security—is also the weakest. Computers are inherently vulnerable. Universities and large businesses must provide students and employees with access to computers by telephone. Such access allows others to invade those computers over the same phone lines. In industry, employees need to be able to use the company's mainframe computer to create a product. Thieves can easily transfer information from the mainframe to a small computer disk, which they then carry out or mail home. Because workers may need access to their colleagues' computer files, they often know several passwords besides their own. The theft then occurs without the "audit trail" needed to identify the culprit.

The obvious solution is to restrict access to the company computer. But tighter security makes developing a product more cumbersome, directly affecting the bottom line. Worse yet, it takes a toll on employee morale and productivity. One industry giant refuses to increase security because it would interfere with the firm's "atmosphere of trust"—even though the company has suffered at least a million dollars in theft losses over the last five years. The priorities of most Silicon Valley executives I have spoken to are similar.

Competition is an enemy of security. Unless every company is willing to accept the consequences of tighter restrictions, careful companies will lose money. Managers are unwilling to risk wholesale employee defections and lower sales for the largely invisible and long-term benefits of preventing theft.

Even if a computer crime is reported, the odds of arrest and conviction greatly favor the criminal. Although

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a few cases come under federal jurisdiction—especially if they involve telephone fraud or export-control violations—most computer crimes are the responsibility of the local police department and district attorney. Police departments are simply unsuited to the task.

Most police officers are not computer experts. They are unable to evaluate claims that a suspect has stolen trade secrets, and do not know how to trace unauthorized computer access. Many cases have been lost because an officer serving a search warrant did not know how to preserve evidence discovered on a computer. Horror stories abound of floppy disks being left in overheated evidence lockers or on the seats of police cars in the sun. More than once, a police officer who was not computer-literate has allowed a suspect to log onto a computer and destroy vital evidence without interference.

Since local police departments are unsuited to catching computer offenders, high-technology regions need special teams of well-trained cops.

The only way police departments can investigate computer crimes effectively is to develop and maintain expertise. Special investigative units have been set up within a handful of police departments, including those of Los Angeles, Philadelphia, and Baltimore, as well as the Illinois State Police, the Tarrant County, Tex., District Attorney's Office, and the Arizona State Attorney General's Office. The Santa Clara County District Attorney's Office, where I work, maintains a high-technology unit in association with various Silicon Valley police agencies. Unfortunately, such units typically consist of one or two overworked investigators, and prospects for expansion appear dim.

One reason police departments hesitate to commit officers to investigating computer crime is that industry's problems are not a high priority. Because they are locally funded, police departments must concentrate on the problems that affect their community most visibly, such as drugs and street crime. The immediate victims of computer crime are seen as a small, wealthy group.

Industry further loses support by its reluctance to report computer crime. Although no statistics are available specifically for offenses involving computers, a study by Lois Mock, of the National Institute of Justice, and Dennis Rosenbaum, of the University of Illinois at Chicago, has found that only about 18 percent of trade-secret thefts are referred to law enforcement for prosecution. Industry security managers say companies fail to report crimes partly because they fear that publicity will alarm stockholders and advertise their vulnerability to attack, and partly because they lack confidence in the ability of law enforcement to respond.

Police departments also shy away from computer crime because the investigations are unusually complex. For example, it is sometimes necessary to infiltrate computer-based "pirate" bulletin boards run by hackers. These boards frequently offer stolen information to a select group willing to reciprocate. They can be treasure troves of stolen passwords, telephone access cards, credit card numbers, and illegally copied software. Although these pirate boards are usually open to the public, the illegal information is accessible only with special passwords.

With patience, skilled police officers using their own computers can gain the confidence of a board's operator and be allowed to enter those "secret levels." Police then obtain search warrants for telephone records, find the operator's home address, and seize the computer containing the stolen information. Recently, after infiltrating a bulletin board that pandered to pedophiles, police in San Jose discovered a plot to kidnap a child and kill him as part of a "snuff" film. The FBI arrested the conspirators in Virginia.

Not surprisingly, such investigations consume a lot more time than the average fraud case. Many, if not most, require coordination with other agencies. In tracing a hacker through several states, investigators must weave their way through the procedures of different telecommunications companies and computer networks, and through the restrictions imposed by federal privacy laws. Overlapping state and federal jurisdictions create their own problems.

Because the investigations are so demanding, cops on the computer-crime beat need a much lower caseload than other officers. A typical fraud investigator can handle 25 or 30 bad-check cases at a time. A computer-crime investigator may be overwhelmed with 5 cases, and be lucky to investigate 30 in a year.

To make matters worse, department policies often discourage qualified officers from volunteering to investigate computer crime. Promotions through the lower ranks are based upon skills learned on patrol, not at a computer terminal. Thus, officers requesting to stay

on a computer assignment risk not being promoted, and those who wish to pursue their interest in computers leave law enforcement for more lucrative positions in private industry. What's more, police departments generally rotate officers through different assignments every two to three years. The learning curve for a computer-crime investigator is so steep that most officers are just becoming valuable when they are transferred.

Many of the same problems plague prosecutors. Most are not computer-literate, and the skills required to prosecute ordinary crimes are not readily transferable. Lacking skilled police backup, prosecutors must often investigate cases without assistance. Because of these tasks—and the time it takes to prepare for trial—a pair of prosecutors handling computer crime might file 25 cases in a good year. This conflicts with the emphasis many counties place on heavy caseloads.

Because computer crime is too much for traditional law enforcement to handle, the bulk of computer offenses go unpunished. Probably fewer than 250 cases have been prosecuted in the United States during the past decade. At this rate, prosecutions are too rare to deter computer crime.

If an offender is convicted, the usual penalties are also not much of a deterrent. Prisons are already overcrowded with violent criminals. So in sentencing a white-collar computer offender, a judge usually imposes a fine or community service, or sometimes a short stay in the county jail—but rarely a prison term. In some cases, offenders are even rewarded for their crimes, getting hired by computer companies as "security consultants." Recently, a 14-year-old offender said he had committed the crime so that the victim or some other company would offer him a job. Clearly, society can do a better job of discouraging people from becoming computer offenders.

Taking a Byte out of Crime

There are two elements to deterrence. First, potential criminals must be convinced that they will be apprehended. Second, they must be convinced that their punishment will be unacceptably harsh. Current methods for dealing with computer crime include neither element.

The only realistic way to improve the chances of catching computer offenders is to take the problem out of the hands of local police departments. A promising solution is for states or the federal government to fund regional task forces staffed by officers and prosecutors from local agencies. Those task forces would enjoy statewide jurisdiction, but be placed in high-technology regions. California, for example, might need three task forces of varying size—one in San Jose to cover Silicon Valley, one in Los Angeles, and one in San Diego. Police departments in the region, and possibly federal agencies as well, could lend officers to the task force for a period of, say, three to five years.

In addition to investigating crimes such as telecommunications fraud, theft of proprietary information, alteration of data, and software piracy, the task forces could assist local agencies in preserving and analyzing computer evidence seized in other cases. This function is becoming increasingly important as criminal enterprises (particularly narcotics and prostitution rings) rely more heavily upon computers for record keeping. One computer-crime unit recently helped authorities sift through floppy disks containing records of 40,000 customers of a large prostitution ring.

Swooping down and seizing a young offender's computer brings home the consequences of computer crime in a way that later judicial proceedings cannot match.

The task-force approach has several advantages. A stint of several years would give officers time to build proficiency. The prestige conferred by government funding would attract qualified investigators, particularly if salaries were set slightly higher than the norm for law enforcement. And industry would be more willing to report problems if it perceived that law enforcement had become organized, funded, and committed to fighting computer crime. Moreover, many company officials to whom I have spoken believe industry would gladly assume some of the cost of maintaining task forces. In fact, the terms of state or federal grants for task forces could require that trade associations contribute matching funds.

A regional task force of six full-time police officers and two prosecutors (plus equipment and periodic training) would probably cost about $750,000 a year. But the return on this investment could be swift. Even if the average computer crime caused losses of only $75,000—and some surveys put that figure much

higher—a task force would be a success if it deterred 10 crimes each year.

Tailoring the Punishment

The other element of deterrence—the certainty of harsh punishment—must reflect the fact that our penal system is already strained to its limit. Certainly, the worst offenders ought to do time; states should require that computer crimes resulting in damages of over $500,000 carry a mandatory four-year prison sentence. But it is possible to devise penalties that deter crime without burdening either the prisons or the taxpayers.



Many offenders depend psychologically and economically upon computers. They spend all their time with computers, and they work, or expect to work, in the computer industry. Thus, punishments that impinge upon this obsession will do more to curb abuses than fines or community service ever could. I suggest three such sanctions: confiscating equipment used to commit a computer crime, limiting the offender's use of computers, and restricting the offender's freedom to accept jobs involving computers. These penalties would be supplemented by a few days or weeks in a county jail—longer in serious cases.

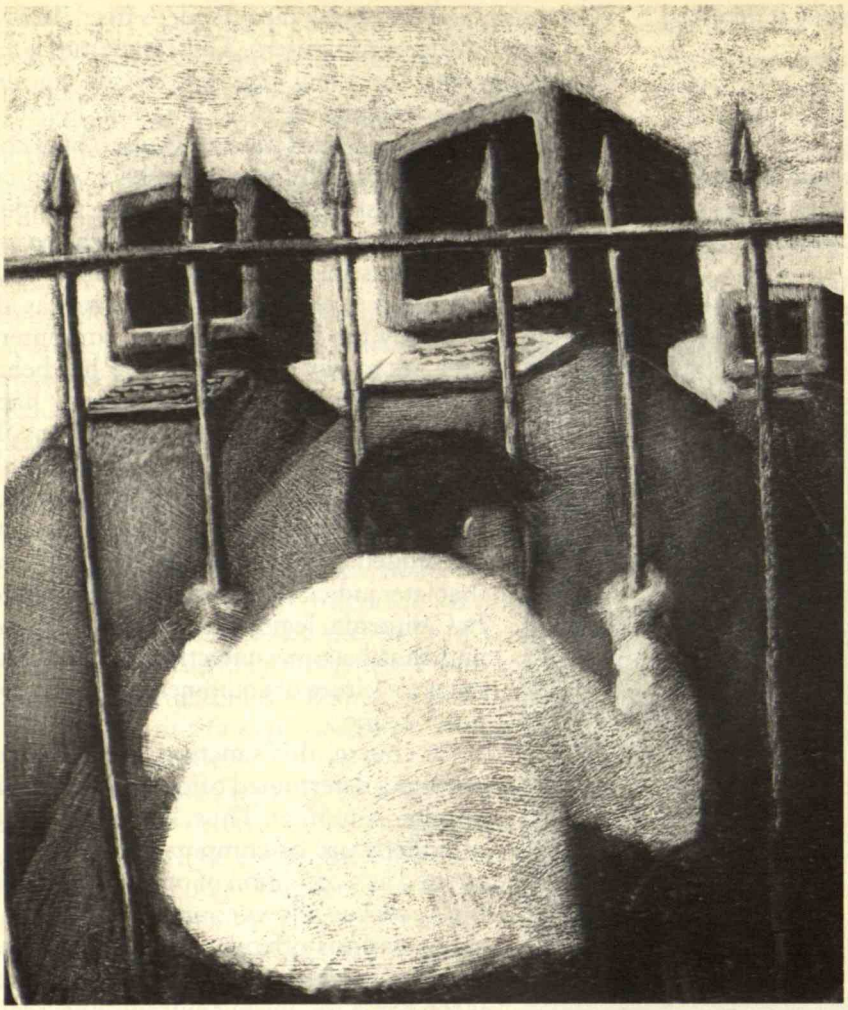
In my experience, one of the best ways to hurt computer offenders, especially young hackers, is to take away their toys. First of all, the loss of the computer is worse than a few weekends picking up trash. Second, computers are too expensive for many young offenders to replace; nor are parents as likely to buy the juvenile another computer as they are to pay a fine on his or her behalf. Third, juvenile offenders are not happy about losing all the software—and possibly illicit information—on their disks. Finally, the sight of police swooping down and seizing an offender's computer brings home the consequences of computer crime in a way that later judicial proceedings cannot match. In California, legislation that I coauthored, and that becomes effective in 1990, mandates forfeiture of equipment used in a computer crime.

Of course, this sanction alone does not prevent a determined offender from buying another computer. Thus, in many cases, the offender's use of computers should be restricted as a condition of probation. California's new law allows courts to consider barring a serious offender from any access to computers whatever. Although this remedy is too harsh for any but extraordinary cases, offenders could at least be forbidden to possess or use modems. Without a modem, the hacker is out of the game.

The most powerful sanction against computer offenders is to restrict their livelihood by preventing them from working with computers for a certain period after conviction. Because many offenders cannot imagine doing anything else for a living, the foreclosure of a career in computing is a disaster to be avoided at all costs.

There are precedents for such punishment. In California, for example, a judge may prohibit an offender from engaging in employment related to past criminal behavior. And doctors and lawyers found guilty of misconduct are routinely barred from practicing their profession. The only problem with extending such a prohibition to computer professionals is finding reasonable limits.

Since computers pervade the workplace, an outright ban on working with them could rule out almost any employment, and could pose constitutional problems. Thus, while California courts may consider barring offenders from computer-related work by forbidding



The most powerful sanction against computer offenders is to prevent them from working with computers after conviction.

them to use computers, period, this power will probably be exercised only in extraordinary cases. For most offenders, a less drastic measure will be sufficient: allowing them to work with computers only after they have notified prospective employers of their convictions. Under the new California law, an offender may be subject to this restriction for three to five years. After applying for a job, the offender must attend a hearing along with the prospective employer to determine whether the computers he or she would use on the job are linked to others, and whether allowing the offender access to those computers would pose an unacceptable risk to society.

Although disclosing an offender's criminal history to employers is unusual, it is not without precedent. Government agencies may check the criminal records of candidates for a variety of jobs, both public and private, such as reading gas meters or working with minors. The records of applicants for various licenses—prospective security guards, alarm agents, and lawyers, for example—may also be checked. Nor will it be difficult to ensure that offenders are complying with the notification requirement. They already have to provide their probation officers with the name and address of their employer at all times.

Another measure that states should consider is setting up a "computer offender registry" for repeat or serious criminals. Bonding companies would have access to those records, and industries would decide which positions were sensitive enough to require bonded employees.

Regardless of the method, barring offenders from sensitive positions in computing will protect society by preventing *and* deterring computer crime. Offenders will not be able to obtain jobs where they pose a threat, and potential offenders will realize that they risk losing the most interesting work in computing.

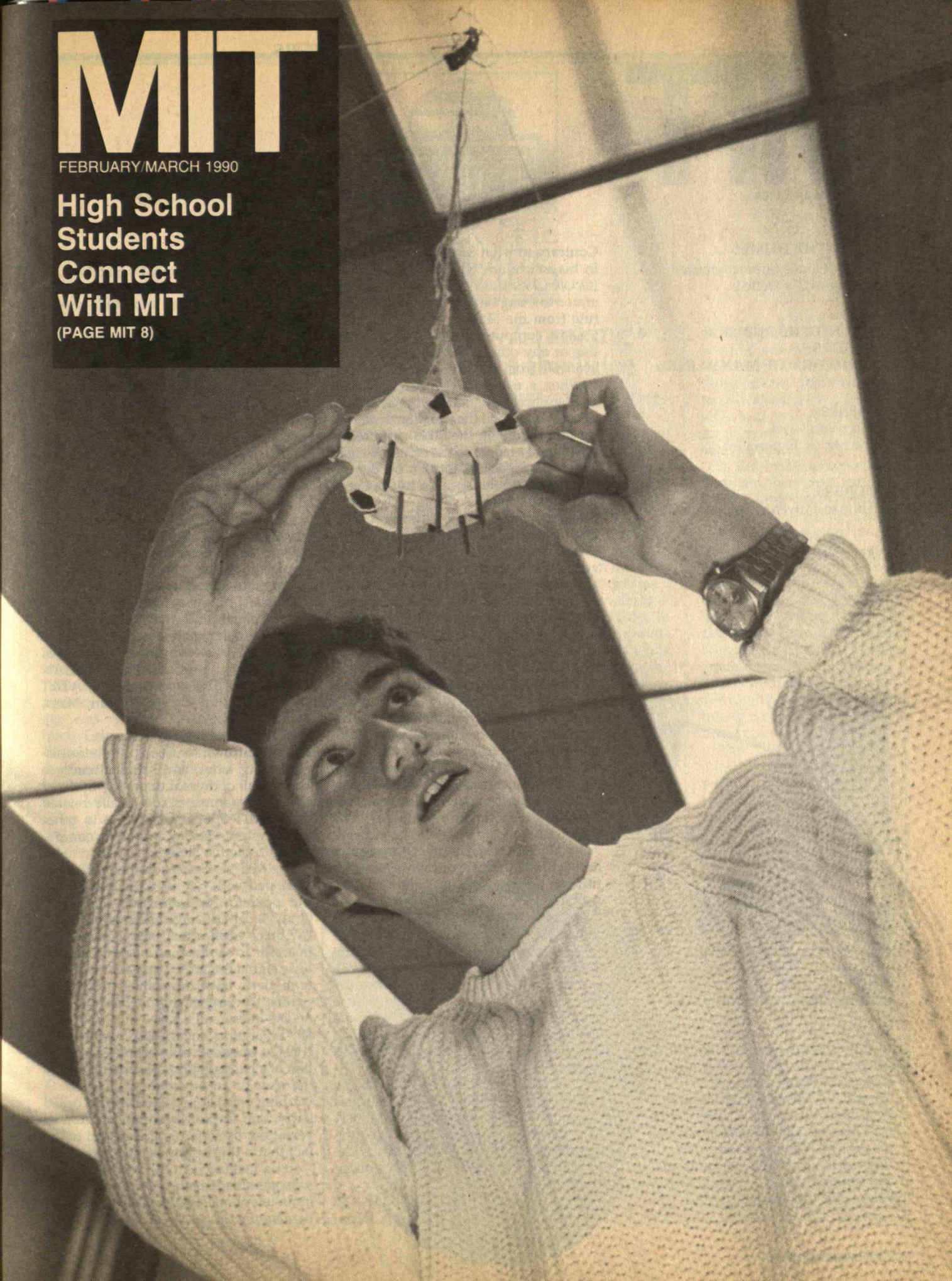
As a growing threat to our economy, the problem of computer crime needs to be addressed immediately. Unlike drugs and street crime, it cannot be deterred by putting a cop on every corner. But we can put teams of smart, well-trained cops into every high-technology region in the country. We cannot afford to build prisons to hold all the computer offenders. But we can impose sentences that exploit their unique vulnerabilities. ■

MIT

FEBRUARY/MARCH 1990

High School Students Connect With MIT

(PAGE MIT 8)



MIT
FEBRUARY/MARCH 1990

UNDER THE DOMES 2
An In-House Supercomputer
Paring MIT's Deficit

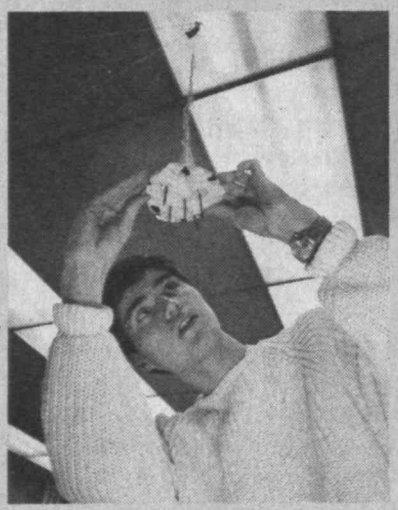
MIT AND THE PUBLIC SCHOOLS: A NETWORK OF MANY LINKS 8

CLASSES 18
"Jon Von" and the Mr. T. Experience 32

COURSES 35
Human-Powered Submarine 40

OBITUARIES 43

PUZZLE 45



COVER:
John Paschkewitz, 16, from Bedford, Mass., was one of hundreds of high school students on campus for "Splash," a weekend of intellectually engaging lectures and activities run by MIT students. Paschkewitz is working on a Rube Goldberg apparatus that demonstrates principles of physics and mathematics. Article on page MIT 8. (Photo by Paula Lerner.)

A Question of Phone Security

Contrary to what Scott Campbell wrote in his article on "The Twilight Phone" (*October 1989*), it *is* possible for an operator to "bug" any phone in the Institute from the 5ESS console. Moreover, a short computer program *could* make this or any other capability of the 5ESS available from any phone in the system.

When a user lifts the handset of an analog phone, the handset is activated. In contrast, when the user lifts the handset of a phone on the 5ESS system, the unit sends a signal to the central switch, which then decides to turn on the microphone and the speaker in the handset. A programmer sitting at the 5ESS console could just as easily turn on the microphone in any telephone in the system at will, and thereby listen to conversations in the room.

The switch can also be programmed so that a specific piece of software will be run whenever a given phone number is punched in. Even in Centrex systems, there are many "magic" phone numbers that technicians use to diagnose and fix problems without returning to the central office. Until recently, for example, dialing 12008888888 in Cambridge activated a program that repeated the phone number from which the user had dialed. On digital 5ESS systems, it should be much easier to write a simple program enabling one to bug any room by dialing a special number followed by the number of the phone to be bugged. After all, the 5ESS is a digital computer and can, theoretically, provide arbitrary functions if given the appropriate software.

Moreover, unauthorized organizations that wished to bug a room by tapping the line would no longer have to use electronic equipment that is very sensitive, hence very expensive, to detect the changes in inductance in a phone's microphone or a television set's speaker. Instead, they would need only a device that tells the phone to turn on its speaker.

I hope that instead of accepting glib assurances about what the 5ESS can and cannot do, somebody at MIT is seriously considering the impact of this technology on society before it comes into widespread use on more than just college campuses.

MARK KANTROWITZ, '89
Pittsburgh, Penn.

AT&T responds:
The 5ESS switch is AT&T's flagship central office switch; it is normally used by telephone companies to provide service to their customers. More than 30 million lines of this equipment have been shipped to telephone companies and other customers around the world. The security safeguards we employ to protect the 5ESS switch and the information it carries on the public telephone network are second to none.

With regard to the specific points raised by Mark Kantrowitz: first, it is not possible to activate the microphone in an MIT ISDN set (the new phone sets installed with the 5ESS system) that is not in use and thereby eavesdrop on calls. Nor are there so-called "magic phone numbers" that can provide access to the software code of the switch for [purposes] of reprogramming.

We believe that MIT's security safeguards will adequately protect the 5ESS switch and its users from any intrusions.

EUGENE MULLIGAN
Account Manager, AT&T
Boston, Mass.

MIT Telecommunications responds:
Mark Kantrowitz raises a number of issues in his letter, and I shall attempt to address all of them. Let me say up front that my response is specifically related to the MIT 5ESS system, not to other 5ESS systems nor to any other computer-controlled switching systems.

The MIT 5ESS attendant consoles are equipped with two features that enable the operator to interrupt a call (not "bug" a call) during certain conditions:

- "Busy verification" allows a console operator to verify that a line sending a busy signal is actually in use. A warning tone alerts both the calling and called parties to the fact that a third party is on the lines.
- "Emergency override" permits the console operator to override any function of a particular line in order to advise the user of an emergency situation. A warning tone is provided to the called party, and in the case of an active conversation, both parties are alerted to the fact that a third party is on the line.

In no instance can the MIT 5ESS console operator activate microphones in remote telephones within the system.

Continued on page MIT 7



UNDER THE DOMES

Plugging into the Country ...

The word infrastructure generally brings to mind a web of (steadily deteriorating) roads, rails, and bridges holding the country together. But there is a less visible, flourishing filigree connecting our national dots as well—the information infrastructure. High-speed computer networks linking universities, research labs, industry, and government are becoming ever more intricate and encompassing.

Until a year ago, MIT's primary access to such linkage was via the von Neumann Computer Network in Princeton, N.J., a 22-school regional network which was beginning to get crowded. Now MIT has helped develop a system that is several times faster than any other regional network. The New England Academic & Research Network, or NEARnet, was founded in late 1988 by MIT, Harvard, and Boston University, and its members now include Bolt, Beranek and Newman, Inc. (the facility operator), Digital Equipment Corp., MIT's Lincoln Labs, Encore Computer Corp., the Massachusetts Microelectronics Center, Thinking Machines Corp., and 11 others.

NEARnet uses both leased circuits and microwave transmission, operating at speeds of up to 10 megabits bits per second; the highest data rate in the nation's other regional networks is 1.5 megabits per second. NEARnet links participating local area networks (LANs) and in turn is connected to other regional and international networks. Users can send electronic messages, log on to remote computers, and transfer large blocks of information quickly.

Applications include medical imaging, semiconductor design, scientific research, library linkage, and supercomputing; the latter involves the Connection Machine Network Server (CMNS) project at Thinking Machines, a massively parallel data-processing system with 64K processors in a hypercube architecture.

As an NSFnet regional network, NEARnet is part of the Internet, a collection of more than 500 networks, 50,000 computers, and 70,000 users. □

... Cranking Up the Juice Here at Home

Two years ago, MIT was negotiating to purchase an SX-2 supercomputer from the Nippon Electric Company (NEC) and Fujitsu. But the U.S. Department of Commerce warned that the Institute might be subject to antidumping duty proceedings. The argument was that Japan was attempting to "dump" its supercomputers at unfairly low prices while blocking U.S. access to the Japanese market.

The ultimate persuasion, Provost John Deutsch, '61, said in November 1987, was that "in the course of the bidding process, it became clear that important elements of the federal government would like to see MIT acquire a supercomputer based on U.S. technology. The federal government provides research grants to MIT, and the views of the government had to be seriously assessed by us."

So the Institute agreed to drop its plans and instead use the John von Neumann Center for Scientific Computing in Princeton, N.J., which is equipped with several domestically produced supercomputers. According to a report in the *Boston Globe* last year, several MIT researchers found the von Neumann Center inadequate in terms of hardware and communications capability, and urged the Institute to reconsider getting its own supercomputer.

Plan "B," so to speak, is a joint, five-year effort in supercomputer research between Cray Research, Inc., and MIT. The Institute has leased a Cray-2/4/256 supercomputer, which has four central processors and more than 2,000 megabytes of memory. The machine is valued at $7.5 million. Known as "ed," the system was installed last summer and is available to all members of the MIT community for a rate of $140 per hour. Able to compute at speeds in excess of 1,000 times the rate of small workstations, ed is ideal for analyzing research data, as well as any project involving vectorization or parallelization. Cray Research has provided a grant to make the supercomputer available for educational and coursework projects—and already

The Cray-2: greatly enhanced computer power, home-grown.



PHOTO: R. FIZZ

nearly 200 hours on the Cray-2 have been allocated for graduate and undergraduate classroom use.

Said MIT's Vice-President for Research Kenneth A. Smith, '58, when announcing the venture: "We are very pleased that Cray initiated this far-sighted agreement for a joint research effort." Cray's particular interests in the endeavor lie in developing networking protocols and educational materials for instruction in the use and application of supercomputers. □

Getting Deficit Under Control

Last April *Technology Review* reported that MIT was facing a possible $6 million deficit in Fiscal 1989, after five years of running slight surpluses in operations. Now that FY 89 has been duly tallied, that deficit actually amounts to a little over $5.4 million, according to a report prepared by Vice-President for Financial Operations James Culliton. The shortfall was funded without dipping into endowment by using reserves and various other funds, including $2 million from a loan delinquency reserve no longer needed and $1.6 million in income from the research reserve.

The MIT administration has taken steps to reverse the trend and break even by 1991. This will entail, among other things, an increase in tuition, 50 additional places in the freshman class, and reduction in salary increases over the next few years.

The report attributes the major reasons for the 1989 deficit, as well as the general decline over the past six years in available surplus, to "the need to provide competitive salary increases, particularly for faculty; a planned reduction in the number of undergraduate and graduate students; higher employee benefit costs, particularly for health care; increased unrestricted fund support to meet full undergraduate financial need; higher real estate, capital, and legal costs; and a lower research base growth than in recent years, particularly compared to increases in instructional costs."

The total FY 89 federal research support increased by only 2.4 percent, while nonfederal research funds grew by 19.3 percent. Last year, for the first time, industrial support overtook the National Science Foundation as the fourth largest sponsor of campus research after the Departments of Energy, Health and Human Services, and Defense.

The total operating expenses for FY 89 were $947,175,000, and total operating revenues and funds were $935,870,000. Slightly more than half of the $11,305,000 difference was made up by unrestricted gifts, leaving the deficit of $5,423,000. An ad hoc committee convened by Provost John Deutsch, '61, has developed a revised budget that projects a $3 million deficit in FY 90, a balanced budget in FY 91, and a small surplus in FY 92.

"We do not wish to project a severe financial problem [in the event that growth is restored] in research efforts, the campaign achieves its goal of limiting demand for unrestricted funds, and the present revenue enhancement and cost reduction programs achieve balance," said the report. "Conversely, we do not wish to be complacent about serious shortfalls which could become even more significant in the future and permit the Institute to become less financially sound than it is at present."

The report also noted that the operations deficit "masks the underlying financial strength of the Institute," which has been enhanced by the increase in restricted endowment and its income that have resulted from the *Campaign for the future.* □

Extra Help Pays Off

After a bumpy start and some major retuning, Program XL—initially a fall-semester adjunct to Project Interphase— is off and running at MIT. And the report so far is that the 60 participants are finding significant benefits from the extra help.

For 21 years, Project Interphase at MIT has existed to help fill any gaps incoming minority freshmen might have in their academic and social readiness to attend MIT. As an invitation-only, eight-week summer program, Interphase provides mathematics, physics, and writing classes, study-skills seminars, and an introduction to MIT and the Boston area.

The general consensus is that Interphase has been a success in making up some of the difference in advantages with which students arrive at MIT. But several areas have eluded attempts at improvement. For instance, although 85 percent of non-minority students who matriculate at MIT receive degrees within five years, only 70 percent of minority students do so. In addition, the grade-point averages of minority students are consistently lower than those of their non-minority colleagues, and a higher percentage of minority students receive academic warnings or are requested to withdraw from the Institute.

Enter XL—a voluntary program open to all freshmen who feel they could use extra help (with priority going to Interphase participants). Students who enroll are encouraged to register for no more than 54 credits their first semester, including a six-credit XL seminar. They also meet for two two-hour study groups each week, one in physics and one in math. The study groups are small—only five or six students—and are guided by graduate and undergraduate tutors. A weekly lecture series given by MIT faculty, alumni, and invited experts includes such topics as "Tools for Success," "Mind Mapping/ Memory Development Technique," "Institute Resources," and "Career Options/MIT Alumni Role Models."

At semester's end, all but two participants in the program were at or better than class average in freshman physics—and the highest score on the midterm exam was earned by an XLer.

This opportunity to excel will continue because Assistant Dean for Student Affairs J.J. Pitts has found funding to extend the program through the spring semester. □

ALUM• NEWS

Family Weekend Draws 1,300

When the staff of the Association of MIT Alumni and Alumnae planned the launch of MIT Family Weekend, they figured it would start out small—maybe a few hundred participants. It takes time for families to become accustomed to scheduling a new activity, especially one that may involve traveling some distance, doesn't it?

Well, apparently *everybody* connected with MIT learns fast, because the very first time it was offered, Family Weekend drew more than 1,300 family and friends of MIT students to campus on October 20-22. They came from 45 states and Puerto Rico, and from 13 foreign countries and 5 continents.

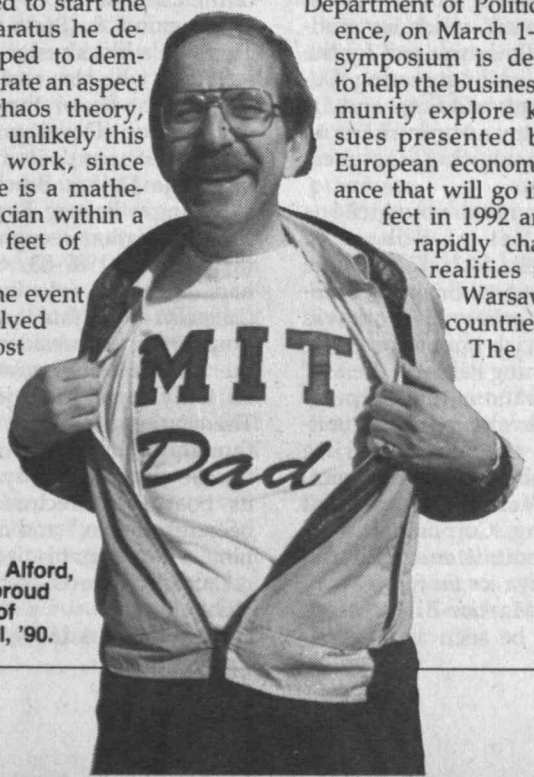
On Friday, hundreds of guests braved a driving rain to take part in activities all over the campus. Among other things, they learned about Project Athena, toured the Materials Processing Center and the Nuclear Reactor Laboratory, heard the latest scoop on financial aid and career planning, and experienced a lecture by one of the Institute's most charismatic young faculty—Jeremy Wolfe, member of the Department of Brain and Cognitive Sciences and holder of the Class of '22 Chair.

Saturday saw addresses by President Paul E. Gray, '54, and by distinguished physicist Philip Morrison and his wife and collaborator Phylis Morrison, and open houses in the academic departments. Alumni/ae won't be surprised to hear that "Doc" Edgerton '23, autographed more than 600 postcards of his famous photographs for weekend visitors to Strobe Alley.

It was an occasion to get an "insider's" perspective on world affairs from economist Rudiger Dornbusch, the "premier international consultant, the first person foreign governments call," according to Suzanne Berger, the head of the Department of Political Science. It was also an occasion to learn that even the most brilliant academic is human after all: Quipped math Professor Steven Strogatz as he prepared to start the apparatus he developed to demonstrate an aspect of chaos theory, "It's unlikely this will work, since there is a mathematician within a few feet of it."

The event involved almost every member of the Alumni/ae Association staff in one way or another, and owed much to the stunning orchestration of Marcia Hartley, manager of the MIT Parents Program, and to the generous and enthusiastic participation of students, faculty, and research staff.

A new tradition is well under way. □



Jack Alford, the proud dad of Meryl, '90.

ILP Considers "New Europe"

MIT's Industrial Liaison Program will present a symposium on "The New Europe: A Global Business Challenge," to be co-hosted by Professor Lester Thurow, dean of the MIT School of Management, and Professor Suzanne Berger, head of the Department of Political Science, on March 1-2. The symposium is designed to help the business community explore key issues presented by the European economic alliance that will go into effect in 1992 and the rapidly changing realities in the Warsaw Pact countries. The symposium sessions will focus on the new political and economic environment, the shape of the new European corporation, economics and finance, approaches to technology management, marketing, corporate strategy, and managing in a global environment.

Speakers will be drawn from government and industry in the United States and Europe, as well as from the MIT faculty. Symposia are usually limited to corporate members of the ILP, but in recognition of the widespread interest in this topic, a special invitation has been issued to MIT alumni and alumnae who work in non-member companies to attend for a reduced fee of $200. All other representatives of non-member companies will be able to attend for $500.

Further information is available from Maria Clara Suva Martin, ILP conference coordinator, 292 Main St., Cambridge, MA, 02139. Telephone: 617/253-0213; FAX: 617/253-0002 □

The Global Warming Debate

Two of the leading spokesmen for opposing positions on the prospect of global climatic change will be featured at Technology Day 1990. Stephen H. Schneider, head of the National Center for Atmospheric Research in Boulder, Colo., and MIT's Richard Lindzen will debate

PHOTOS: L. BARRY HETHERINGTON



B. Angell D. Adams G. Clifford E. Kaswell

"The Threat of Global Warming in the 21st Century—Is It Predictable?" Friday, June 8, from 9 AM until noon at Kresge Auditorium, promises to be one of the most lively mornings MIT has ever put together for the science and technology communities. There will be more information in the April edition of the *Review*.□



Association President Harris Weinstein congratulates "Pink" Salmon on his Kane Award.

Association Honors Its Finest

The 1989 Alumni/ae Leadership Conference (ALC), as usual, focused on the role of volunteers, and the high point of the occasion was the bestowing of honors on many of the Association's most dedicated volunteers.

The highest award the Association of MIT Alumni and Alumnae bestows is the Bronze Beaver, which this year went to four people:

■ **William C. Rousseau,** '36, whose "generous sharing of his time and personal resources with MIT, the Alumni/ae Association, and the Chemical Engineering Department and its Practice School is legendary." Rousseau raised funds for graduate fellowships and for the Chemical Engineering Department building, and he holds an appointment as senior visiting lecturer, emeritus.

■ The most conspicuous activities of **Robert L. Mitchell,** SM '47 "include the National Business Committee, where his work was of crucial importance, the Sustaining Fellows, the MIT Corporation, the Corporation Development Committee, the Sponsoring Committee for the Chemical Engineering Department Building, Corporation visiting committees, and the *Campaign for the future.*"

■ **S. Martin Billett,** '48, "must be seen as the 'volunteer's volunteer.' " He has performed at every level of activity for the Alumni/ae Association and MIT, including posts as director, president, vice-president, and treasurer for the MIT Club of Providence; he worked on telethons, was chair of the Visit Program, and on the Second Century Fund for the Alumni/ae Fund; and served on the reunion committee, as secretary, and now as president of the Class of '48.

■ **Raymond S. Stata,** '57. This was a blockbuster year for Stata, who also received the highest honor that the Corporation Development Committee accords its members—the Dalton Bowl. In awarding a Bronze Beaver, the Association recognized that during 1987-88, Stata had a leading role in the *Campaign for the future* while functioning as president of the Alumni/ae Association; "a truly formidable job." The citation noted that "his thoughtful, incisive support for the alumni/ae body and its board of directors has been invaluable," and made him "a model for his peers."

Lobdell Awards went to eight alumni:

■ **David D. Adams,** '50, who was honored for "his pivotal role in reviving the MIT Club of the Capital District of New York. In 1986, David was the driving force in rekindling interests in the Schenectady Club." The Lobdell also recognizes his long service as an educational counselor and club officer.

■ **Denis A. Bovin,** '69, was honored in particular for his "tireless efforts on behalf of the MIT Center of New York," where he served in numerous leadership roles. He is vice-chairman of the *Campaign for the future* Committee in New York, and a member of the CDC and the Alumni Fund Board.

■ **George F. Clifford,** '48, has held a variety of leadership roles in the Class of '48, and his active involvement with his class's 40th reunion "was an important contribution to making that reunion a record-breaking success."

■ **Ernest R. Kaswell,** '39, is noted for his continuing fund-raising activities, his efforts on his class's 50th reunion committee, his work as a solicitor in the Leadership Campaign, and his role as a class agent.

■ **James N. Phinney** (H '81)



M. Billett R. Stata W. Rousseau

"has been a presence in the New York City Alumni Office for 25 years. He is, rightly, 'Mr. MIT' to many New York area alumni/ae."

■ **Russell S. Robinson,** '32, has been instrumental in establishing the MIT Club of Tucson and in fund-raising in that area. In addition to serving as president, secretary, treasurer, and director of the club, he brought young alumni/ae into the group and enriched the club's programs, establishing a strong foundation that his successors have been able to build on.

■ **Steven W. Swibel,** '68, has been president of the MIT Club of Chicago for the last two years. During that time, he doubled the membership and increased both the frequency of meetings and the attendance, making the club a model for the Midwest. His work as an educational counselor and telethon volunteer have also been notable.

■ **R. Gregory Turner,** '74, was recognized for the outstanding quality of his work for the MIT Center of New York and the Club of South Texas, for the telethons he has chaired, and his efforts as a member of the personal solicitation program and the Education Council.

The Henry B. Kane Award, awarded for only the second time this year, is named for the first director of the Alumni/ae Fund. Given in recognition of exceptional service and accomplishments in fund-raising, the awards went to:

■ **Edgar P. Eaton, Jr.** '44, was honored for his work at every level of volunteer fund-raising since the launch of the Second Century Fund, including service on the Fund Board. He most recently led the first Visit Program in the New York metropolitan area, where the Eaton-led volunteers inspired outstanding giving among graduates in northern New Jersey.

■ **Lewis H. Roosa,** '49, is known not only as a remarkable telethon caller, but as a leader in developing strategy for telethons in the Delaware Valley. In the first year of his leadership in that area, both the number of callers and the dollars raised doubled.

■ **Chenery Salmon,** '26, was the original class agent for the Class of '26 when the Alumni Fund was launched in 1941. After 48 consecutive years in his post he holds the record, and his regard for deadlines, tenacity, and sense of humor exemplify the ideals of the Kane Award.

■ **Bennett M. Zarren,** '61, "is a class president who knows how to get out the vote for MIT," and led his class to a record-breaking 25th reunion gift. As a Fund Board member, he made significant contributions to the class agent program. As chair of the first Fund Visit Program, in the Boston suburbs, "he blazed a trail for the dozens of similar programs throughout the nation." He is the first person to have chaired two visit programs.

Morgan Awards are given to members of the Educational Council whose service has been exceptional. The five 1989 recipients provided, in aggregate, 150 years of service as educational counselors. The recipients are: **Burton Angell,** '43, of Schenectady, N.Y.; **Michael Biancardi,** '40, Wausau, Wisc.; **A. William Avent,** '42, Jacksonville, Fla.; **Norman A. Chrisman, Jr.,** '49, Lexington, Ky.; and **Robert S. Gooch,** '51, Fort Worth, Tex. □

Continued from page MIT 2

Moreover, the MIT 5ESS system does not have any "magic" telephone numbers. It does have a programmed number, 9400, which enables a station user to verify his/her telephone number. The number was publicized in 1988, when MIT made the transition to the new system, as there was no reason not to do so. Nor is the MIT 5ESS accessible to a person who is physically removed from the switching hardware and who attempts to reprogram the system and/or a specific telephone line by dialing into the system.

Is it theoretically possible to develop software that will do the things that Mark Kantrowitz suggests can be done? Yes, however, to do so would require the skill to change the software embedded in the switch as well as physical access to the switch and to the connections between it and the telephone lines. There are people capable of making the software changes, but those skills are not universally held. In any case, the MIT 5ESS switch sites are reasonably secure from unauthorized entry, and the console operators cannot make changes to the software.

In closing, let me say that I share Mark's concerns about the basic issue in all this: privacy. MIT Telecommunications Systems has attempted to address issues of privacy and security in a manner satisfactory to the MIT community.

MORTON BERLAN,
Director, MIT Tele-Communications Systems



MIT Reaches Out to the Public Schools

BY DAVID P. HAMILTON, '89

Everybody talks about the weather, but nobody does anything about it.

—Mark Twain

As just about everyone knows who's picked up a newspaper or tuned in the evening news within the past seven or eight years, primary and secondary education in the United States is a mess. Education experts and standardized test results consistently deliver the same dismal message: American students trail their counterparts from other industrialized nations in just about every subject area, be it geography, science, or languages.

Like talk about the weather, talk about the state of public education is cheap and plentiful. Few policymakers, however, have presented clear proposals for



Elaine Hall (far right) brought insights gained at an intense summer workshop sponsored by MIT's Materials Processing Center back to her students at Quabbin Regional High School in Barre, Mass.

action; still fewer are offering to fund programs to improve the system.

It may have looked to some that MIT was part of that syndrome. After all, President Paul E. Grey, '54, has employed every possible forum to decry the public schools' failure to turn out graduates who understand the scientific and technological principles that govern their daily lives. Yet MIT does not have a school of education and in fact folded its Division for Study and Research in Education in 1982.

But, on an individual or small group basis, it turns out that there are so many projects involving MIT students and faculty with youngsters in the schools that it is virtually impossible to produce an exhaustive list. Moreover, although the quality of secondary education does have a direct impact on MIT's recruiting and admissions, the motives that draw members of the MIT community to these endeavors are more diverse and humane than simply a concern for the quality of our applicant pool.

Some of the school-related programs that engage MIT faculty and students are new and others are decades old, but the volunteers all recognize a need to take the benefits of MIT to the less privileged. Jim Nowick, G, a co-founder of the Chemistry Outreach Program, spoke of a "moral responsibility" to give something back to the community. Other volunteers described their desire to spend more time with children, or to "make a difference" in a student's life.

What follows is a sampling of the MIT community's ties to public education.

Taking Science to the High Schools

In the fall of 1987, Nowick and a fellow graduate student in the Department of Chemistry decided to convey some of the excitement of their field to high-school students. Several months of planning and organization transformed the idea into the Chemistry Outreach Program, a traveling demonstration with accompanying lecture that reached nearly 500 high-school students in the spring of 1988.

In some sense, it was almost inevitable that students of Professor Rick Danheiser would come up with a new way to encourage high-school students to consider scientific careers. Danheiser is well-known for "brainwashing" his students about the problems created by a scarcity of science majors in American colleges and the popularity of fields like investment banking. He encourages his students to think up imaginative ways to stimulate interest in chemistry and the other sciences.

Nowick and Ron Brisbois were among his converts. Once they aired their pro-

PHOTOS: L. BARRY HETHERINGTON

NSF is now considering funding programs patterned on MIT's Chemistry Outreach Program.

posal for a chemistry road show, Danheiser limited his involvement to offering encouragement and sounding out ideas. "I didn't want any role in running the thing," he explained. To Danheiser, the program's strength derived largely from the fact that its creators are graduate students with a fresh perspective on what makes scientific work rewarding to young people.

The program itself is an attempt to "strike a balance between chemistry's visual appeal and its intellectual foundations," as Nowick and Brisbois described it in an article in the September/October 1989 edition of the *Journal of Chemistry Education*. Consisting of a series of attention-getting experiments with a running theoretical commentary, the program was designed to bypass students' natural resistance to scientific theory by making the learning exciting and painless.

High-school students made the ideal target audience. Not only does this age group have the necessary background to understand the theory, but Nowick and Brisbois found it easier to avoid the trappings of "authority figures" and to identify with students closer to their own age than they would have with a younger group.

Furthermore, high-school students are generally facing their first tentative career decisions and most have never heard of the attractions of graduate study in science, Nowick said. "There are fewer classes," he told them. "You get to do research, and you get paid to go to school. It's a nice package." Being able to discuss work on the "cutting edge" of chemical research only added to the speakers' appeal.

Much of the material Nowick and Brisbois presented was intended to reveal chemisty's relevance to modern life. For instance, synthesizing the compound azulene gave the duo a chance to illustrate the scientific method in action while describing how azulene is used in both cosmetic pigments and anti-ulcer drugs. AIDS came up when the graduate students described the chemical basis of AZT, one of the first drugs to slow the progress of the disease.

A simple polymerization reaction was the most visually exciting experiment of all. "We'd mix this stuff up, and out would come flying this big rubber snake," Nowick said, explaining that the heat of the reaction generated enough vapor to force the polymerized chemical from a corked bottle. Even this demonstration had its serious side, allowing the lecturers to explain how chemists design and develop materials to serve specific purposes.

In marketing Chemistry Outreach, the two contacted science department heads at 38 local high schools, of which more than 30 percent showed interest. During the spring of 1988, they took their demonstrations to nine or ten high schools, nearly one every week. Many schools asked for repeat visits.

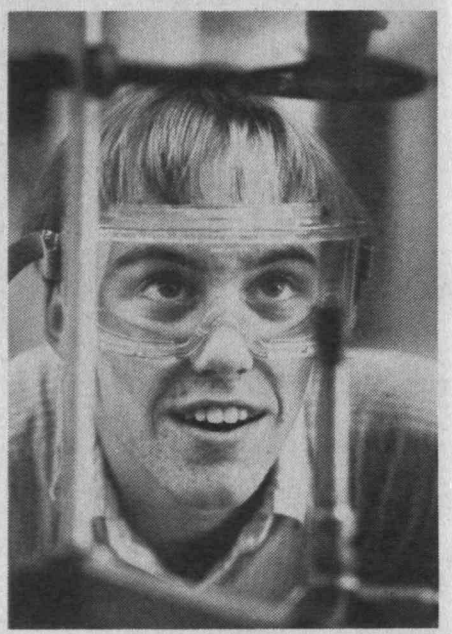
The program has attracted a great deal of attention, most notably when the National Science Foundation flew Nowick and Brisbois to Washington last April to present their demonstration to a receptive audience. "This program was unusual insofar as it was conceived and carried out by graduate students," said Kenneth Hancock, deputy director of the NSF chemistry division, which is considering financial support for similar efforts as part of its 1991 budget.

Funding for the MIT program came from the Chemistry Department and the School of Science. "We spent $500 to reach 500 kids, which was a pretty good deal," Nowick said. He and Brisbois also received $1,500 apiece as a travel allowance, which enabled them to make a presentation before a meeting of the American Chemical Society in Dallas.

A team of five undergraduates took over the program for the 1988-89 academic year, allowing its creators to return full time to their graduate studies. Although the time Nowick and Brisbois invested in this program was time away from their research, Danheiser's support was unwavering. "Ron and Jim were a little naive about the amount of time this would take," Danheiser said, but he is convinced that the potential benefits of the program are well worth the time sacrificed during one semester of a degree program that typically extends four to five years.

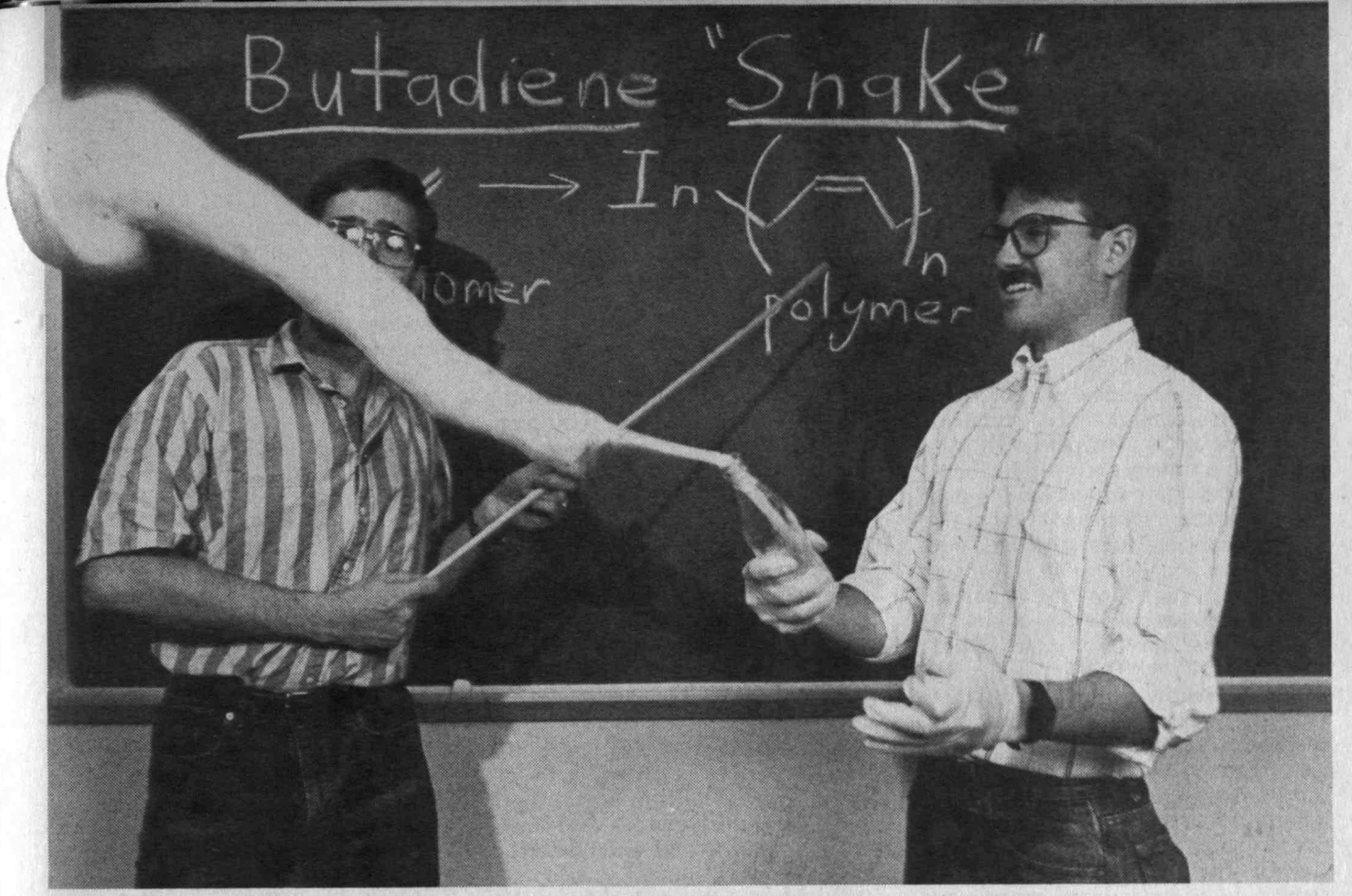
Not to be outdone, a team of six undergraduates in the Chemistry Department have produced their own educational program, a chemistry "magic show" for fourth through sixth graders. "There's so little in the traditional curriculum in which to be excited about science," observes the program's director, Bob Rich, '90. "We want to convince students that it isn't just hard work."

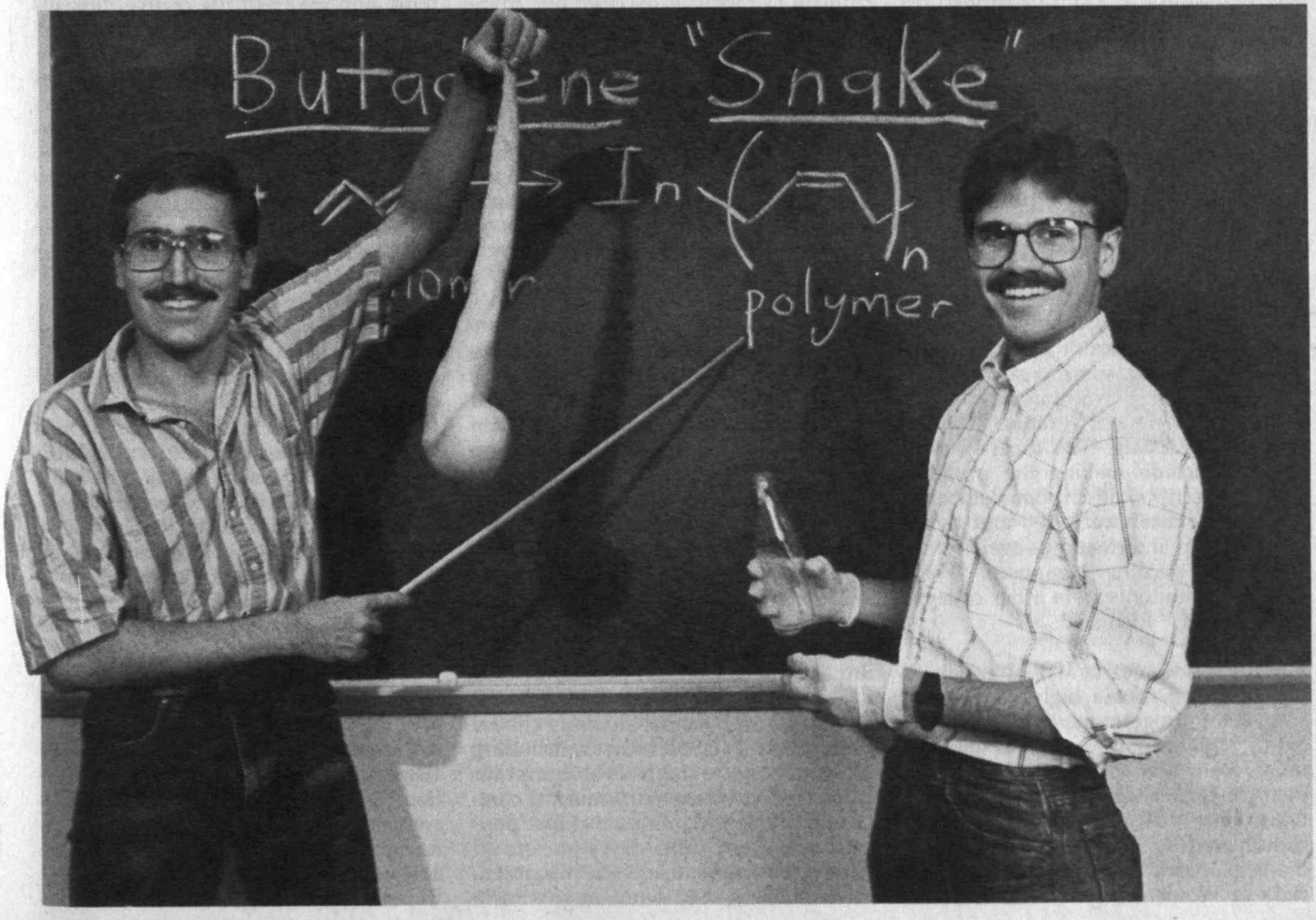
The show is organized as a series of



Top: The fascination of science is brought home to this student at Quabbin Regional High School. Right: The show-stopper for the Chemistry Outreach Program founded by Jim Nowick (left) and Ron Brisbois was a polymerization reaction that pops the cork.

David Hamilton, a former news editor of The Tech, *completed a combined bachelor's and master's degree program in Course VI and is now a reporter/researcher at* The New Republic.


Butadiene "Snake"
polymer


"Snake"
polymer

Some 300 teenagers spend Saturdays in MIT's student-run High School Studies Program.

skits involving chemical concepts that are often played for laughs. In the "coffee" sequence, for instance, Rich badgers another student for some coffee. When the other student produces a flask of clear chemicals with a smeared set of instructions, Rich adds it to a petri dish of acetone, turning the mixture dark brown in a starch-iodine reaction. After pouring this "coffee" into a styrofoam cup resting in its own petri dish, Rich turns to the audience to describe the reaction, while the cup behind him is slowly dissolved by the acetone.

The organizers held a trial demonstration at a Winchester, Mass., elementary school last May, to generally enthusiastic reactions. Teachers told Rich that kids "talked about the program for weeks." The MIT team were planning to give demonstrations at three more schools during the January 1990 Independent Activities Period (IAP).

If the magic show has a drawback, it is the fact that it's geared to elementary schools where the science curriculum is already strong, as is the case in Winchester. The children need to understand a set of preliminary experiments supplied to teachers and performed before the MIT students arrive. "It's [also] important to do something for children without a strong science background," Rich acknowledges, "but our show's not entirely appropriate for those without reasoning and mathematical skills."

Considering the time constraints they're under as MIT students, the program's developers put an impressive amount of effort into its preparation: they met for more than six hours per week, for which they received academic credit through the Undergraduate Research Opportunities Program (UROP).

The organizing group, made up of two sophomores, two juniors, and two seniors, is designed to renew itself as members graduate. The team's future projects include making the program material—scripts, descriptions of experiments, chemical "recipes," and safety and cleanup information—available to their peers on other campuses. "We'd like to see students from other colleges get involved," Rich said.

The Association of MIT Alumnae, or AMITA, runs a high-school visitation program aimed at encouraging high-school women to take as much math and science as possible to increase their academic and career options. Since 1979, the program has been coordinated by the AMITA office with the help of local volunteers from the Society of Women Engineers (SWE) and the Association of Women in Science (AWIS), nearly half of whom are MIT alumnae.

The AMITA program coordinators advertise the program by mailing flyers to between 250 and 300 public and private high schools roughly within the border of I-495. In 1988-89, teams of two or three professional women made presentations before audiences selected by the guidance counselors at nearly 40 area schools. The volunteers, who work or were educated in scientific and technology-related fields, talk about how their careers have been shaped by taking courses in math and science.

Chris Jansen, '63, an MIT technology licensing officer who has volunteered for the program since its inception, became involved in the program because of her concern about the low numbers of women applying to MIT in the late 1970s. She discovered that female students often stopped taking math and science courses early in high school, leaving them unable to take advantage of opportunities at MIT and other technical universities.

The impact of this type of outreach is difficult to measure. At least one high-school counselor reported that more girls in her school are applying to top colleges and universities. Denise Horan, guidance director at St. Mary's High School, said the visitation has helped "back up" the parochial school's strict math and science requirements. Sometimes the schools invite the speakers back for talks and programs unrelated to the AMITA visitation.

Teaching high school—at MIT

Teaching high school students is the *raison d'etre* for the Educational Studies Program (ESP), which offers advanced courses to 9th through 12th graders in a college atmosphere. Now more than 25 years old, it provides a rare opportunity for MIT undergraduates and graduate students to design courses around just about any subject that interests them.

ESP actually consists of three separate programs offered at different times throughout the year. The High School Studies Program (HSSP) meets on Saturdays throughout the spring term. About 300 high-school students choose from nearly 30 HSSP courses, including introductions to high-level computer languages, contemporary musical composition, and the program's most popular course, the SAT review. "Everybody wins," said ESP Chairman Steve Worley, '90, who taught introductory physics last year. "MIT students acquire teaching experience, and the high school students learn something different."

In the fall, ESP presents Splash, a one-weekend extravaganza of one-hour and two-hour lectures that attracts anywhere from 150 to 200 students. For a $20 registration fee, participants can learn about nearly anything, be it commonplace (contract bridge), highly cerebral (an introduction to infinity), or downright esoteric ("Samurai no Kokoro: The Spirit of the Samurai"). The program is hardly frivolous; nearly 19 of the 34 lecture offerings in 1988 dealt with serious topics such as vector math or the biology of AIDS.

Far more demanding of both instructors and students is ESP's third and newest program, Junction, which offers a semester's worth of learning to committed students in an intensive eight-week summer program. The curriculum is severely restricted, offering only chemistry, calculus, pre-calculus, physics, computer science, and critical thinking. Classes of 2 to 14 students meet for an hour and a half every weekday evening, and many of the course descriptions warn prospective enrollees that homework will be assigned daily. Some courses are billed as adequate preparation for the College Board Advanced Placement tests. As if the program didn't sound serious enough, there is the cost to consider: one Junction course sets a student back $300, while two courses taken simultaneously go for $500. (Financial aid is available to any student who asks for it, and usually covers at least half of the fee.)

Worley has a personal understanding of the impact these programs can have on students; he credits his own HSSP experience with kindling his interest in physics, a field he intends to pursue into graduate school. "When I came to MIT, I knew I had to teach for ESP," he said. Other ESP teachers have gone on to obtain teaching certificates, often by taking education courses at Wellesley; they benefit from the fact that experience as an ESP instructor fulfills one of three fieldwork assignments Massachusetts requires for certification.

Over the years, ESP has cultivated lasting relationships with a number of area high schools that provide a pool of interested students. These schools range from highly competitive institutions in affluent neighborhoods to less competitive schools, Worley said. Unfortunately, the program has not been able to attract African-American or Latino students in large numbers—the ma-



jority of ESP participants are Caucasian or Asian, split almost evenly between males and females.

There is at times a surplus of volunteers wanting to teach in ESP, although their enthusiasm makes this no surprise. "I like contact with the kids," said Ken Graves, '88, a graduate student who has been with ESP since 1986. "I'll go out of my way for extra exposure." Another instructor, Dave Policar, '90, has considered teaching as a career. "I like the idea of helping others find out what's going on with the material," he said.

Reaching into the Community

Two years ago, a chance meeting with a high school science teacher led Professor Ronald Latanision to offer a series of tours through the Materials Processing Center (MPC) to teachers and students representing about 20 different high schools, in groups of about 80. After hearing a short talk about the variety of research conducted at the laboratory, the group would tour the facilities, where such materials as superconducting ceramics or single-crystal silicon wafers are made.

Response to the program was unexpectedly enthusiastic. When teachers were asked how to make the tour more effective, a majority said that they'd benefit enormously from a longer stay on campus. As a result, 52 teachers from high schools throughout New England descended on MIT in the last week of June 1989 for an MPC-sponsored program that involved faculty and researchers from the Schools of Science, Engineering, and Management.

Providing "a real look at how science is done at MIT," the program was a rigorous set of lectures and tours that exposed the teachers to basic scientific principles. "We wanted them to see how engineers pull scientific disciplines together to solve problems," said Linda Breisch, MPC communications officer.

If the earlier program had been received eagerly, the longer stay positively invigorated the participants. "It was a wonderful time," said Elaine Hall, a physical science teacher at the Quabbin Regional High School in Massachusetts. "They told us that what we got is more intense than what most MIT freshmen [experience]." Although they found some of the lectures a bit too technical, teachers liked the logical presentation of unfamiliar ideas, and everybody claimed they learned something. The only oft-voiced complaint was a variation on the usual MIT pace-and-pressure theme: many teachers suggested that they could absorb the material better if it were spread over two weeks or even



Top: Debbie Bouchard, '90, a Cambridge School Volunteer, helps Ruth Pierre at Cambridge Rindge and Latin High School. MIT programs cover the gamut, from one-on-one tutoring to the impact of a stimulated teacher on a whole class.

Latanison's workshop inspired science teachers to organize to promote educational change.

presented in two separate sessions.

The program struck a nerve, and over the Veterans' Day weekend, 43 of the teachers reconvened with the MPC staff to launch NEST—New England Science Teachers. The group sees itself as a vehicle for change, and formed five committees to work on its immediate priorities:

- to create a briefing package to accompany a videotape of the program to be sent to other educators, news media, and government officials;
- to produce a newsletter for the approximately 6,000 science teachers in New England;
- to develop a mentoring and curriculum resource program through which high school science teachers work with their colleagues in the elementary schools;
- to review accreditation requirements that make it difficult for retired scientists to help meet the shortfall of 300,000 science teachers projected for elementary and secondary schools by the turn of the century, and critique other aspects of the education profession that hamper effective science teaching;
- to develop a sensitivity to issues in science education among legislators and other government officials and raise science education higher on the list of priorities for public funding.

Current plans are to hold one or two similar sessions next summer, and the possibility of opening the program to teachers nationwide is under discussion, Breisch said.

Secondary-school students are "part of our family—they're our customers, in a way," Latanision observed. "The continuance of MIT's educational mission is really a two-way street." Although he readily admitted that MIT is not singlehandedly going to solve the nation's problems in technical education, Latanision said he hopes this project contributes to a ground swell of grass-roots programs at the nation's technical schools. Such programs not only address the needs of the secondary schools, Latanision contends, they also provide rewarding experiences for the technical schools' faculty and students.

As a research-based institution, MIT is well aware that it is the nature of experiments to fail at least some of the time. But often the experiment that doesn't work contains the seed of the one that will, a reality that also applies to projects in the schools. In 1974, the court supervising the desegregation of the Boston schools requested that MIT form a partnership with the Mario Umana High School to create a science and technology magnet school. Nearly a dozen years later, MIT pulled out of the project, stating that the Boston School Committee was breaking its promises, ignoring MIT's advice, and adopting a "yo-yo" approach to managing the program.

MIT had hired Alan Dyson as executive director for the Umana effort from 1982 until the Institute withdrew in 1986. As the problems with that program became more intractable, the superintendent of the Cambridge schools invited Dyson to help design the "school of the future." By 1983, Dyson could see that he was not being a lot of help to Umana, so he began devoting about 20 percent of his effort to the Cambridge schools. By 1984, when Robert Peterkin took the job of Cambridge superintendent, Dyson's Cambridge work had grown to fill more than 40 percent of his time.

Peterkin's desire to form a coalition among universities, business, and the public schools finally came to fruition in October of 1986, when he and Dyson put together the Cambridge Partnership for Higher Education. The Partnership is a nonprofit organization that identifies knowledgeable people and technical resources among the partners and plugs them into the school system. It started with 14 members—MIT, Harvard, Lesley College, and several businesses such as Polaroid, Lotus, and BayBank Harvard Trust—and has since grown to 41. By 1992, Dyson is hoping to see 200 members, most of them commercial, given the enormous potential among Cambridge's nearly 4,000 businesses.

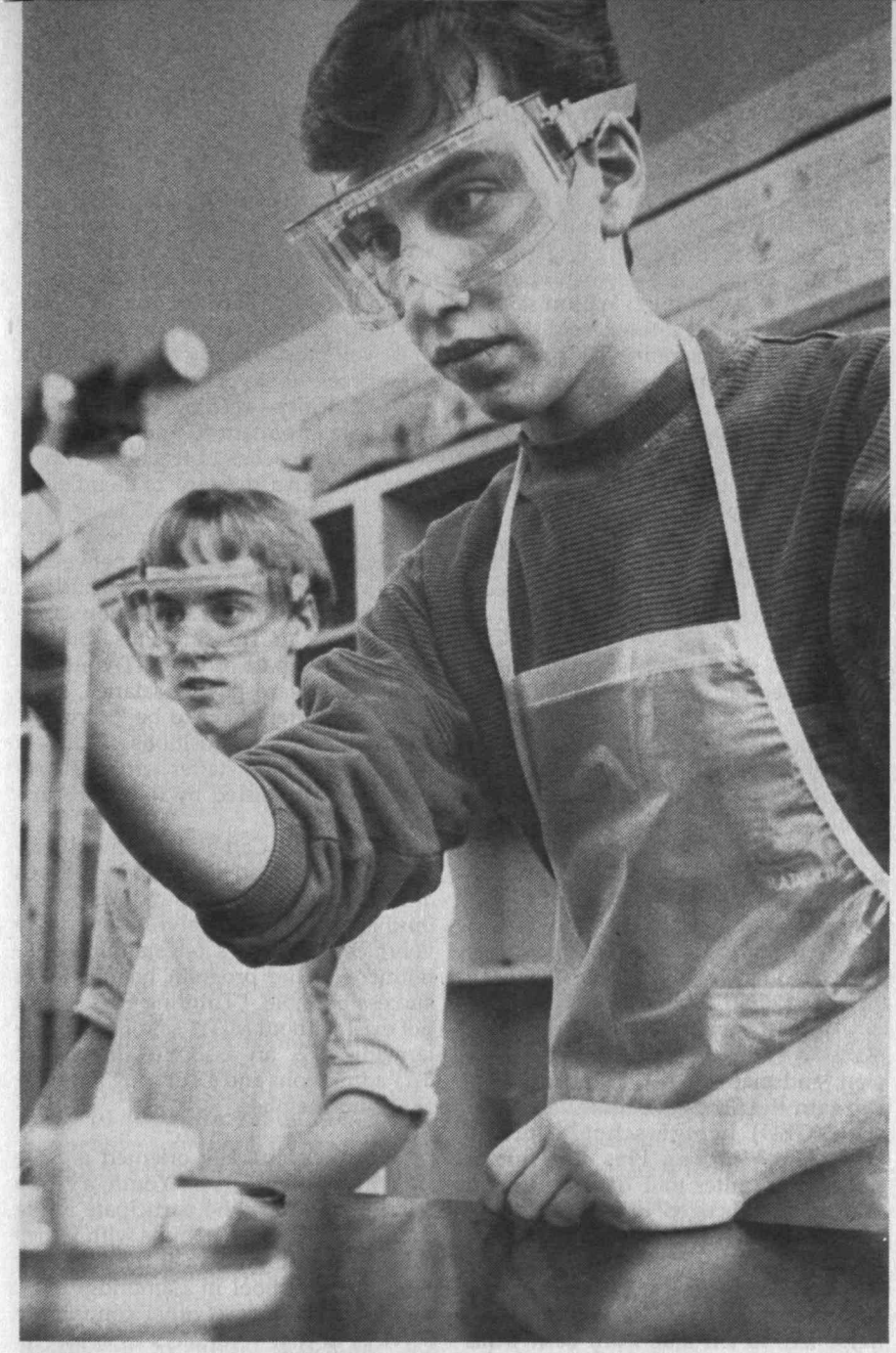
For more than three years, Dyson has been officially on leave from MIT to work for the Partnership, although MIT continues to donate office space and 25 percent of his salary. Several MIT administrators, including Walter Milne, assistant to the chairman of the Corporation and the president, and Isaac Colbert, an associate dean of the graduate school, also play a variety of roles on the Partnership's board of directors. Colbert, for instance, provides fund-raising advice as well as consulting on the Partnership's computerized financial systems.

Students in the MIT's Sloan School of Management have also contributed to the Partnership's efforts. George Jaquette, '85, put together systems analyses for several issues in the Cambridge school system. He examined the legal and financial implications of small businesses launched within a public school—such as school stores—and of





Animated science classes like these at Quabbin Regional High should multiply in coming years, thanks to the efforts of NEST—New England Science Teachers—an outgrowth of the program operated by MIT's Materials Processing Center.



private fund-raising efforts by school principals.

The Volunteer Consulting Group (VCG), a loose association of MIT management students who donate time to nonprofit institutions, also began working with the Partnership this year. VCG members are particularly interested in how well schools and nonprofit institutions cooperate. "We're looking into the history of these links," Co-Director Paul Zigman said. "Why they succeed, why some don't. It'll be a series of case studies." VCG members spend an average of two hours a week on their consulting work, enough to make progress while not creating undue time pressure.

MIT faculty are also utilized by the Partnership as a consulting resource. One of the more notable efforts is an advisory committee on science in the public schools, which includes such luminaries as physicist Philip Morrison and engineering professor Judah Schwartz. The commission will attempt to answer the questions of what science education in public schools should look like and what relationship should exist between the public schools and universities.

One of the most striking innovations instituted by the Partnership is an effort to encourage entrepreneurial ideas in education. Teachers, either individually or in groups, can compete for grants of $500 to $1,500. One 1989 grant went to teachers who assembled an "Asia box," which included audiovisual materials, art objects, and booklets about Asian culture. Another went to a team at the Harrington School who wrote software for cooperative learning groups as part of their project in critical thinking in geography and social studies. Although maybe only one project in every 10 produces materials that will be widely used, the continued testing of new ideas is a healthy process, Dyson said. This year, the partnership provided $8,200 to fund 10 proposals.

Part of the difficulty in running such a program consists of overcoming mutual suspicion between business and school systems. "Businesses [have been] leery of getting involved in systemic change," Dyson said. "Now they're initiating programs." Lotus, for example, is sending employees to instruct teachers in word processing.

Similarly, school districts are cautious about the influence of the private sector, particularly where issues of policy control are involved. But Dyson emphasizes that "We're not interested in running the schools or running for political office." Partnership members tend to avoid school committee meetings and work through the school superintendent, he said.

As assistant director for education and community relations at the MIT Museum, Marcia Conroy has run a number of educational and tutorial projects over the past several years. Her work with the Mario Umana High School magnet project, for instance, consisted of "awareness" programs that took students on tours of MIT robotics and artificial intelligence laboratories—the "showy stuff," as she described it.

"We also helped students look into the practical side of engineering," Conroy said, "what kinds of opportunities are there, what skills you need, how much money you can make." Other Museum-run programs took place at a community agency known as the Margaret Fuller House and the Peabody Elementary School in Cambridge.

More recently, Conrory decided that her limited staff and budget could be better put to use in the development of an enduring exhibit with educational implications. Entitled "Math in 3D," this program will feature a series of three-dimensional sculptures displayed as art exhibits in order to emphasize their aesthetic appeal alongside their intellectual underpinnings.

Conroy hopes to put together an educational program for fifth graders that will illustrate the beauty of mathematics and its relationship to nature. That program may be available to as many as 120 students each week and will consist of

MIT is the largest single source of financial support for Tutoring Plus.

a one-shot visit to the museum and a follow-up activity kit for teachers. It will have to wait for more money, such as a grant, since resources for such activities are limited.

Engineers in the community

Before members are inducted into the engineering honor society Tau Beta Pi (TBP), they must participate in a community service effort. Many members choose to fulfill this requirement by recruiting tutors for the Cambridge School Volunteers (CSV), an organization providing tutoring services for students at Cambridge Rindge and Latin High School.

In the fall of 1988, for instance, TBP staffers managed to attract 40 volunteers from the MIT community. The number of TBP members involved in these efforts varies from term to term; corresponding secretary Arthur Lent, '90, estimated that 10 to 15 members were involved in the 1988 fall efforts, and another five did recruiting last spring. Many members, including Lent, also volunteer for the program themselves.

The effort didn't go unnoticed on the Cambridge side. "We've had an MIT presence for a number of years, but last year we had a *real* presence," said Jay Wilson, the high-school coordinator at CSV. The additional volunteers made MIT one of the program's largest sources of volunteers, second only to Harvard (with an undergraduate student body of 6,587, as compared to MIT's 4,325). Most volunteers come from area colleges, although a growing number of Cambridge business employees donate their time during lunch hour or before work. According to Wilson, CSV had 325 volunteers last year who worked with nearly 350 students.

Tutors are paired with students on the basis of common interests, meeting for two 50-minute sessions per week; volunteer assignments usually last at least a full semester. MIT volunteers often tutor two students in successive periods, an arrangement that makes better use of the volunteer's time and doubles his or her exposure to students. Although most MIT students prefer tutoring in math and science, many also work in foreign languages and English subjects such as writing and spelling.

CSV volunteers also work in classrooms, where most of the assignments are in English as a Second Language. Several experimental programs include math and science teaching in ESL. Volunteers generally assist teachers who are dividing classes into small groups in order to give students as much attention as possible. "If an individual can get over the fear of teaching English to someone who doesn't speak it at all, it can be very rewarding," Wilson said.

Lent, an algebra II tutor, said the experience was exhilarating. "It's very rewarding to see a person understand the material for the first time, and later to see how much better he's doing in class and on tests."

Not all the tutoring is remedial, either. Some volunteers coach members of the competitive high school math and science team, or they "adopt" students over IAP and help them build projects for the science fair held in February.

MIT students also maintain a healthy presence in Tutoring Plus, a Cambridge-based program run out of the Margaret Fuller House. Twenty-five years old as of last October, Tutoring Plus combines academic and civic resources to aid the youth of the Cambridge area, according to program director Ann Budner.

The core of Tutoring Plus has always been a one-on-one tutoring program in which volunteers meet with students aged 6 to 18 for academic coaching. Each year, 20 to 25 participants spend at least two hours each week learning basic skills in writing, reading comprehension, and mathematics. Older students can earn the Graduate Equivalency Degree (GED), a high-school diploma equivalent. Tutoring Plus also runs a homework center four days a week to which students aged 10 to 18 can bring academic questions. About 70 students a year attend the homework center.

Two new Tutoring Plus programs were added last year: the Saturday Club helps five to ten kids learn basic skills on Saturday mornings, while a summer program offers four weeks of remedial help for eight participants referred by the City of Cambridge. The summer program concentrates on math, science, reading, writing, and critical thinking.

Satish Reddy, a graduate student in mathematics, worked in the homework center and for the Tutoring Plus summer program. A relaxed atmosphere, an emphasis on a broader range of academic skills, and activities such as tours of local businesses make the program more appealing to students. The homework center, in contrast, is far more structured. "There's a lot of arm-twisting," he said. Any way you slice it, "it's difficult to get students to do their homework," Reddy admitted.

Like many others, Reddy said he enjoyed the contact with kids, as well as the opportunity to learn about the people in Cambridge. He's now more acutely aware that "not everyone in Cambridge goes to MIT or Harvard."

MIT's 1988-89 participation in Tutoring Plus was near an all-time high of 40 to 50 volunteers, many of whom work in the areas where the children have the most difficulty—reading and writing. "It's more important to find tutors with creative approaches to teaching than to find ones with a 'mastery' of their field," Ann Budner emphasized.

The Institute is also the project's largest single funder, providing between a quarter and a third of its $70,000 budget. No other educational institutions provide money to Tutoring Plus, Budner said. A large part of the MIT contribution goes toward paying salaries, since other supporters tend to be "nervous" about funding staff positions. Budner is the only full-time staffer with the program; she is assisted by four part-time coordinators.

As with the Cambridge School Volunteers, tutors come from local colleges and universities and a few Cambridge businesses. Some local residents also volunteer. But MIT's longstanding commitment to the program has made its success possible. "Tutoring Plus would not exist without MIT," said Bonny Kellermann, '72, an associate director of MIT admissions and a Tutoring Plus policy board member.

Less academically oriented are the MIT Volunteers for Youth, a group of students who participate in Big Brother/Big Sister matchups with fourth through eighth graders at the Kennedy Elementary School in Cambridge. The program differs from other community services in that volunteers establish relationships with children who may not be getting enough adult attention, said Paul Tiao, '89, last year's program coordinator.

Volunteers for Youth grew out of a nationwide effort in the late 1960s to get collegiate athletes involved as role models for younger children. MIT hosted one of the earliest seed programs in the early 1970s. Like many other volunteer efforts, participation in the program cycled up and down over the years until the beginning of 1988, when the last matchup had disintegrated and the program was effectively dead. When Tiao inherited it in mid-1988, it clearly needed reform.

For starters, Tiao tightened the interviewing process, requiring longer and more intensive screening sessions for potential MIT volunteers to ensure in-



dividual responsibility and dedication. "The right reason for wanting to do this is that you like working with children and want to make a difference," Tiao said. "Some people just have no concept of what's involved here. One guy came in and couldn't talk about anything but how he could play catch with a kid; he couldn't go any deeper than saying he could show a kid how to play sports. It's really important to avoid matches that don't work out. None of these kids needs to be rejected again."

A second step was to open the program to non-athletes. Given the difficulty of juggling academics and a competitive sport at MIT, many athletes are not in a position to take on the commitment of a match-up. Finally, Tiao avoided spreading MIT Volunteers for Youth too thin by narrowing its focus from three Cambridge elementary schools to just one.

In the fall of 1988, the program boasted of 20 current matchups, and participants hoped to double or even triple the project this year. "We've set the groundwork for several successful years here," Tiao said. Future challenges will be largely organizational. "It's more difficult to control quality with 20 matchups than with two or three," he said. "The challenge for [this] year will be to create effective organization for a larger number of matchups and to continue recruitment."

In general, volunteers are expected to devote two or three hours per week to their relationship on a regular schedule, or to contact their matches by telephone if they aren't available. Many pairs see each other over the summer; some stay in touch long afterward. "It's helped kids to see their real academic abilities," said Carmen Albano, a guidance counselor at the Kennedy School, "and to improve academically, socially, and emotionally." Albano, who interviews the elementary students for match-ups with the MIT volunteers, stays in touch with the program coordinators and the Kennedy students in order to assess the direction and quality of the matches.



Inventive physics experiments and adventures in learning to trust a group are part of "Splash," a weekend extravaganza of short courses for 150 high school students.

Now in its 15th year, the Minority Introduction to Engineering and Science (MITES) offers a six-week summer "mini-semester" of basic science and mathematics to about 50 high-school juniors. The program's main thrust is to convince minority youngsters interested in math and science to go to college and keep studying these subjects. "We want to convince them that it's not just 'hard'," said Administrative Director Bill Ramsey, '51.

The MIT MITES became independent of a two-week nationwide program in 1983, when the School of Engineering assumed responsibility and decided the students would be better served by increasing the program's educational content. That content now includes calculus, physics, chemistry, writing, and structural design taught "just below the university level," said Professor Douglas Carmichael, the MITES academic director. The courses are taught by MIT graduate students and local high-school teachers, some of whom work as resident tutors who live with the students "24 hours a day," Ramsey said.

Perhaps the most exciting activity for MITES participants is a structural design contest modeled on the Institute's famous 2.70 design course. Students compete to build towers out of punch cards and staples that can support a brick for 30 seconds. (Ties are resolved in favor of the bridge with the lowest material "costs.") In a second phase of the contest, students form teams of five to build bridges out of balsa wood and glue. Once built, the bridges are placed in a jig and loaded until they deflect 1/8" or collapse. "It's moving to see these multiethnic groups cheering each other on," Ramsey said.

Although MITES is not designed as a recruitment effort for any particular college or university, it does offer faculty lectures plus general information on financial aid and MIT admissions for participants who might choose to apply. Many do—out of 49 participants in the Summer 1988 group, 39 applied to enter MIT in September 1989, 32 were accepted, and about 20 decided to attend.

Much of the program's funding comes from corporate sponsors who are beginning to see the need for a well-educated minority workforce, Ramsey said. The message has been so clear, in fact, that MITES 1988-89 fundraising exceeded its operating budget for the first time in many years, leaving it with a surplus for the 1990 summer program. The extra money is timely, since the program's coordinators are planning to double its size this summer. Overhead, room, and board for MITES run to about $4,000 per student, a total of around $200,000, of which MIT provides about $45,000 per year from general operating funds. □

PHOTOS: PAULA LERNER



CLASS NOTES

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Caruthers A. Coleman, better known as "Dina," pleased us with this letter: "Since I last wrote you, things have changed a lot. My dear wife, Dora, died last year. I was invited back to NMMI as an honored guest and took my daughter Louise. We went to Santa Fe and Taos. Last August I took my grandson with me to see the Scots Tatoo ceremony at Edinburgh. I caught cold on the *Q.E. II* going over and missed the Tatoo. We came back on the Concord on my 96th birthday. On my birthday the Child Development Center gave me a testimonial dinner. I do not think I am about to make any more long trips. The spirit is willing, but the body objects." Enclosed with his letter he sent a clipping from the *Lexington Herald-Leader* of Kentucky with an article headlined: "Investing in Futures—Caruthers Coleman Honored For Helping Children." He is quoted: "I don't look foreward to being 100. I've seen people that are 100, and they are feeble and have to have someone around all the time. I think the way to go is to leave right quickly. About the Child Development Centers of the Bluegrass, Dina says: "They take a helpless child and in four years teach him to read and write and put him in the public school, and he keeps up with his peers. Now that's a tremendous economic advantage to the community, because every helpless person is a load on somebody and this operation takes the load off. I don't call the money that I spread around there a gift; I call it an investment. I think a dollar invested there makes more return than anything else I've ever fooled around with." The article is great, giving a brief biography of Dina's life and accomplishments and noting that he retains the title of president of his company and goes to his office daily for an hour. Asked about how he wants to be remembered by Lexingtonians, Dina responds: "I don't care if people remember me or not. There's a poem that says, 'Lives of great men all remind us that we can make our lives sublime and departing leave behind us footprints in the sand.' What it does not say is, "Along comes the evening tide and washes the footprints away." As he has been all his life, Dina continues to be an extraordinary man and, without intending to, he challenges us to be better ourselves and to work towards making this a better world for all mankind. God bless you, Dina. Keep writing.—**Bob O'Brien,** acting secretary, 25 Keith Rd., Pocasset, MA 02559

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A recent feature in the *Summit* (N.J.) *Independent Press,* recalls **Ray Brooks'** World War I flying career. Several of the accounts have been reported before, but one, originally written in 1963 by a military historian, I had not heard before. On Ray's first air mission, Ray, his commanding officer, and another pilot were unexpectedly confronted by two German planes, a gunner and an observer. Ray, by going for the observer, put his CO in a better position to take out the gunner. As the historian observed, it clearly illustrated that the young flyer was more interested in coordinated and organized action than in claiming victories at the expense of endangering a fellow pilot. Subsequent victories, as you probably recall, earned him the Distinguished Service Cross, the Silver Star, and the Silver Medal of the City of Paris.

Reading about Ray gave me an excuse to call him. He recently was flown by one of his pilot buddies to a "do" at the Rhinebeck Museum, a World War I aerodrome museum in the Rhinebeck, N.Y., area. There he had his usual opportunity to fly his friend's Piper Cub.

Ray sounded great on the phone, but due to bad eye sight at age 94, he can no longer respond to the letters he continues to receive. Having seen his old *SPAD* when it was in tatters at the Spring Hill Restoration Center being repaired for its current place of honor in the Smithsonian in Washington, I do hope someone is responding to those inquiries, especially if they are from youngsters whose racing cars can far exceed the old *SPAD*'s top speed of 130 mph.

I know Ray is proud of the A. Raymond Brooks Scholarship Fund at MIT to which he has consistently contributed over the years. I've never heard him mention its magnitude. I hope he will forgive my disclosing to his classmates that as of this writing his Fund has a market value at MIT exceeding $425,000.

The *Boston Globe* reported the death of **Thomas Knowland** in Charlotte, N.C. During World War I, he served as second lieutenant in the Chemical Warfare Service and helped invent the first suit to protect against mustard gas. In 1961, he retired from Boston Woven Hose where, during his 43 years of service for that company, he developed 50 U.S. and international patents on such products as tires and high-pressure hose.—**Don Severance,** acting secretary, 39 Hampshire Rd., Wellesley Hills, MA 02181

18

Faithful **Herb Larner** has sent me several friendly notes over the past summer. Most recently his contribution was his correspondence with President Bush concerning some activities in South Africa. . . . I am happy to learn through the grapevine that **Eli Berman** was married last October. He and his new wife, Christina, live in Chestnut Hill, Mass., but left for Coronado, an island near San Diego, Calif., for the winter. They plan to return in April. Christina has three great-grandchildren, and Eli has five great-grandchildren. Both of Eli's sons graduated from MIT. Congratulations and best wishes for your happiness.

I record with sorrow the death of **Tom Knowland,** 95, who lived in Charlotte, N.C. He was a former manager of product development for Boston Woven Hose and Rubber Co. During his 43 years with the company, he developed 50 U.S. and international patents on such products as tires and high-pressure hose. During World War I, he served as a second lieutenant in the Army Chemical Warfare Service and helped invent the first suit to protect against mustard gas. He had two sons, five grandchildren, and two great-grandchildren.—**Max Seltzer,** secretary, 865 Central Ave., Needham, MA 02192



Herb Larner, '18, with Abraham Lincoln Bronze at the Scaife Art Museum, Carnegie-Mellon University, Pittsburgh, Pa.

19

Due to eye surgery, I postpone the current *Review* notes hopefully to the next issue.

I have been in touch with **Leo Kelley, Audry Ames, Don Way** and **Doc Flynn.** They are all doing well.—**W.O. Langille,** secretary, Box 144, Gladstone, NJ 07934

20 70th Reunion

Please send news for this column to: **Harold Bugbee,** secretary, 313 Country Club Heights, Woburn, MA 01890

21

Only two news items this month. Your secretary received a letter from Robert W. Ellis, '46, telling of a party given last September 8 to honor **Leo C. Pelkus** in celebration of his recent retirement from a 50-year career in the industrial electric heating industry. The occasion was attended by his two daughters, Dianne and Dori, as well as present owners and employees of the company that bears his name. Thank you, Robert Ellis, for your letter.

I also received a letter from Edith (Mrs. **Harry)**

Thomas, who had read my recent class notes about Maxine and **Cac Clarke.** This recalled to the Thomases the days when they worked with Cac for Victor Talking Machine Co. in Camden, N.J. In 1967, Harry and Cac co-authored a book for Prentice-Hall. Harry got his BA from Tufts in 1924 and an SM from MIT in 1925.—**Sumner Hayward,** secretary, Wellspring House E64, Washington Ave. Ext., Albany, NY 12203;**Samuel E. Lunden,** assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

22

Martha Eiseman Munzer continues her fine literary work. Her tenth book, *Lauderdale-by-the-Sea, A Living History* was commissioned by the town and published last November by JMG Publishing Corp. It is called a living history because it is compiled from interviews with old-timers as well as newcomers. For our 70th, perhaps we should commission Martha to write the history of '22.

Last August **Marjorie Pierce** was the subject of a laudatory article in the *Wayland Weston Town Crier* covering her exceptional services to the town of Weston. Quoting from the article, Marjorie said, "I've designed 49 new houses in Weston. But most of my practice is alterations, building upon what is already there. There is hardly a street that I haven't done work on." She is most proud of her work in the town center where she helped to build or renovate 13 buildings. The owner of one of the commercial properties whose building was altered last year to Marjorie's design said she "is one of very few people who could take this project and make it into a work of art. She took a building that would have been very pedestrian and transformed it into one of the most outstanding buildings in the center of town. She's dynamite." Retirement is still some time away.

Will other still active '22ers please report.—**Yardley Chittick,** secretary, Route 1, Box 390, Ossipee, NH 03864

23

You may have wondered about the lack of 1923 notes in the November/December *Review.* Because of a mix-up, they were not included and were slated for the January 1990 issue instead. I am getting together these notes in the middle of November, so at this time, I have no knowledge of the reply to our mini-reunion slated for March. You should have received your brochure and all necessary information by now. A good time is promised.

In the meantime, the call for letters from our class members produced a response from **Monte Tomerlin** concerning our classmate **John "Tex" Beretta.** He states that Beretta celebrated his 90th birthday this past March 31. John is doing well and living with his daughter's family Jackie Tomerlin. His mailing address is: 215 Parklane Dr., San Antonio, TX 78212. We thank you, Monte, and would be pleased to know a little more of John's life since he left the Institute. Best regards to him.

Our president, **Royal Sterling,** has sent your secretary a number of incidents or memories of the Institute. He tells of a friend student who owned an old jalopie. On the way back to the Institute from a visit at Royal's home in Lowell, Mass., the car stalled in the middle of Harvard Square, thereby stalling traffic. As was quite usual in those days, the car had to be pushed out of the way. One of my memories in my freshman year occured when, after a party at Walker one evening, practically all the class formed a parade, shouting and singing, over Mass. Ave. bridge into Boston. Bridge repairs were in progress and the red lanterns were lifted to light our way. However, being the class that we are, I remember that most or all were returned on the way back.

Class of 1923, let's hear from you. Did you get your reservations in for our mini-reunion?—**Frederick O.A. Almquist,** secretary/treasurer, 63 Wells Farm Dr., Wethersfield, CT 06109

24

Nancy McNeal, daughter of **Oaklee E. Charlton,** writes to tell us of the passing of her father last May 12, who had experienced declining health for the past two years. She says that her father frequently recalled fond memories of his college times and that his life was a credit to the Institute because he exemplified these ideals and integrity throughout his professional and personal life. That is a fine tribute to the Charlton family and MIT. Thank you for writing, Mrs. Nancy McNeal.

The executor of the estate of **Charles S. Stodter** wrote to tell the school of the passing of Mr. Stodter on October 24, 1988. Condolences to all family and friends.

Hello everyone out there! What is happening in your lives? Anything we can publish? I would love to hear from you.—**Katty Hereford,** secretary, Hacienda Carmel No. 237, Box 5397, Carmel, CA 93921, (408) 625-7737

25 65th Reunion

Three classmates attended the fall meeting of the MIT Club of Cape Cod: **Ernest Stone** and your secretary, who are members of the club, and **Stanley Lane,** who was down from Maine visiting his brother Norman, '29, who lives in South Yarmouth on Cape Cod.

Long before you read these notes, you should have received letters from **Courtenay Worthington** and **Sam Spiker** regarding the 65th reunion. If you have not responded to them by now, do so promptly. It is not too late.—**F. Leroy "Doc" Foster,** secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

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I have no notices of classmate deaths this issue. I hope you are all well and enjoying life.

I did receive more material on **Peter Bellaschi** of Portland, Oreg., expert on lightening, about whom we have previously reported. (I wish more of you would send information about yourselves.)

An article enclosed, "The Vicinity of Newberry Center in Central Oregon," is a wonderland of scenic, recreational, and scientific features. Newberry is also literally and figuratively one of the hottest prospects in the state for producing electricity using the heat of the earth. There is a proposal to ask Congress to create a 600,000-acre Newberry National Monument run by the U.S. Forest Service. The proposal backers want the Forest Service to develop a plan that would protect the area from defacement by geothermal plants and logging while developing it for tourism and recreation. A bill has been introduced in Congress that would allow this development but still preserve the park.—**Donald S. Cunningham,** secretary, 27 Lowell St., Braintree, MA 02184

27

Renewed youth to our class! Our president has taken a bride. **Harold "Bud" Fisher** married Janet Sawyer last September 23. Let this be an example to all our widowed classmates. They are taking a trip to New Zealand in November to enjoy its summer and its mountainous terrain. Stay tuned for more.

Charles Pope missed the shock and devastation of the recent earthquake. After living on California Street in San Francisco for many years, he moved last year to Richmond, Va., to be near one of his family.

Charles J. Pedersen of Salem, N.J., received his SM in chemistry in our class and joined Du Pont's Jackson Laboratory in New Jersey. At that time, Du Pont formed the nucleus of a basic research department that produced such useful substances as nylon and teflon. Other important advances were taking place in tetraethyl lead and new petroleum chemicals, new elastomers, and a new series of fluorocarbons for refrigeration and aerosols. One of Pedersen's accomplishments that had a strong commercial impact was a dramatic improvement in the process of making tetraethyl lead, the gasoline additive. He has now been retired from Du Pont for 20 years. He won the Nobel Prize in 1987.

Having reported **Dale Stetson**'s death in last month's notes, I neglected to mention his most well-known accomplishment—a mural that runs the length of the East River Savings Bank on Wall Street. The canvas, specially fabricated in England, depicts an aerial view of New York City. Painted in black and sepia tones, the work picks up the colors in the bank's marble interior. He made his sketches for the mural from the air in the early '30s.

Your secretary has taken a cruise and a little visit to Italy. I succumbed to the ads of the Quarter Century Club and boarded the *M/V Illiria.* Departing from Istanbul, after guided visits to its huge mosques, we stopped to be guided over the recovered city of ancient Ephesus, then the spectacular cliffs of Santorini and white village on top. Despite a howling gale the second day, the 333-foot ship was steady with its stabilizers. We traversed the old Corinth canal at 2 a.m. by being towed with only a few feet clearance along the sides of this steep walled canal. The Adriatic was like a lake with warm breezes where we visited the old cities of Dubrovnic and Split. The cruise ended in Venice and included a large majority of 35 Harvard men and spouses, with only three MIT, but I made the most of my red jacket.

We stayed over for a 10-day visit in the beautiful city of Florence with its grand Duomo and handsome museums full of famous old paintings and sculptures. And, of course, the enticing shop windows. I refer to we, because I had the good fortune to be accompanied by a lady friend of long standing, which made the trip much more delightful.—**Joseph C. Burley,** secretary, North River Rd., Epping, NH 03042; **Lawrence B. Grew,** assistant secretary, 21 Yowago Ave., Branford, CT 06504

28

It is always heartwarming to hear of lively friendships among our classmates. In talking with **Maury Beren** by telephone, we were pleased to learn that wife Rose has been responding very well to her medical treatment. Maury also reported that they, the Berens, had a good dinner meeting recently at one of the new hotels in Leominster, Mass., with Gladys and **Dave Olken** and Ruth and **Abe Woolf.** Abe has made a remarkable recovery from the stroke he suffered just prior to our 60th. His excellent spirit is evident in this recent letter from him: "My thoughts keep going back to our last reunion, the 60th. As with every reunion of the class of '28, it was another exceptional, wonderful time, enjoyed by us octogenarians (a fact of life we can't deny). As you know, the April before the reunion, I submitted to surgery, after which I suffered a mild stroke that left me physically whole, but with some aphasia, a disability to communicate properly. For me, as chairman responsible for all the activities, it was a difficult time. The concern, patience, and support of the reunion committee and all of my friends at MIT were a great comfort to me and to Ruth. We thank them every one. Now, a year-and-a-half since the stroke (my therapist tells me it will go away. . . when?), I'm still working at whatever engineering problems come my way, listening to music, driving up-country to visit the children—keeping a pace befitting an old



Roger Haven, '28, with Alex

man. Ruth and I attended Technology Day in June; we enjoyed it and are looking forward to the 65th reunion of the Class of '28."

Florence and I (your secretary) took our annual fall automobile trip to the forest lands of Maine near Fryeburg. This gave us an opportunity to meet and talk with some of our classmates in that area. **Roger Haven** and his steady companion, a black Labrador retriever named Alex, greeted us cordially at their Fryeburg home. When we went out to dinner, Alex waited for us patiently in the parked car. We spent several pleasant hours with Roger—mostly just reminiscing. That part of our trip included also a visit to the beautiful old farmsite where **Ralph Jope** lived as a boy. The farm now has been nicely restored and made modern.

By telephone, we talked for a little while with **Bill Bendz** in Cumberland Foreside. We were sorry to learn that Marjorie is not well. The next day, in the town of Raymond, we drove through quiet woods to reach Panther Pond where Louise and **Ernie Knight** live in a setting of natural beauty. After a tasty lunch that Louise prepared for us, we sat outside chatting while the afternoon sun gave the water a golden glow. In the distance beyond the far shore of the pond, a 1,500-foot-high TV tower stood out against the sky. Ernie told us that he had once climbed that tower to the very top in wintery weather in order to do a repair job. The tower has a simple elevator but the cable had slipped off the pulley at the tower top. There was no way to replace the cable but by climbing all the way up via the tower ladders and doing the job by hand. Ernie, then 54 years old, accomplished the scary feat with the help of a much younger associate. While back on the ground and resting from that demanding task, a youngster challenged Ernie to a ski run down the hill. When Ernie wearily declined, the young one said to him "Chicken!"

With deep regret, we must report the deaths of three classmates. By coincidence, all three graduated in Course 6A, electrical engineering cooperative, and each of them received the same degrees, SB and SM. **James E. Tully** died October 15, 1989, after a lengthy illness. Jim attended Boston College prior to joining '28 in our sophomore year. Most of his professional career was in electronic engineering with Raytheon Corp. in Newton/Wayland, Mass. Jim had retired to his country home in Fryeburg, Maine, where he remained until recently. Wife Susan predecased him in 1983. They leave a son, a daughter, and four granddaughters. . . . **Henry R. Wengen** died September 9, 1989, at home. His professional life began with Central Hudson Gas and Electric Co. in Poughkeepsie, N.Y. In 1946, he switched to a career in manufacturing by joining Fargo Manufacturing Co. in Poughkeepsie, producers of power service hardware, where he served as vice-president and whence he retired in 1975. Besides wife Virginia, Henry leaves a son, a daughter, and two grandchildren. . . . **Dennistoun W. Ver Planck** died October 8, 1989, after a long illness. Denny's career began at General Electric Co. He then taught electrical engineering at Yale University (1936-1940) and there earned his Doctor of Engineering degree in 1940. During World War II, he served in the U.S. Navy and retired with the rank of commander, USNR. In 1946, he became professor of electrical engineering at Carnegie Institute of Technology where, later, he became head of the Department of Mechanical Engineering. Besides wife Elizabeth, Denny leaves two sons, Peter (MIT '61) and Davie (MIT '69), and two grandsons. A note from son Peter provided the foregoing information. . . . To the families of these departed classmates we extend our heartfelt sympathy.—**Walter J. Smith,** secretary, 37 Dix St., Winchester, MA 01890; **Ernest R. Knight,** assistant secretary, Box 98, Raymond, ME 04071

29

Bill Baumrucker of Marblehead, Mass., writes, "I am still playing tennis twice a week (and aching all over after each session). Doris hasn't told me as yet our travel plans for this year, but we'll be off to someplace I am sure." Bill says when he gets *old,* he will stop playing tennis and take up golf. Since he is still playing tennis twice a week, he is not old enough to make the shift. More power to him!

Thomas W. McCue of Newton Highlands, Mass., writes, "Still working in various business enterprises. Still taking college courses to improve my working skills." . . . **Sam J. Levine** of Swamscott, Mass., writes, "We were unable to attend our 60th reunion because my wife Emma's health. She was in the hospital at the time, but is now home recovering. We will try for the 65th! With a couple of my neighbors, I started taking some courses at a community college. These days, we do mild exercise, go to school, and enjoy a simple life-style. Good luck to all our classmates."

Eric A. Bianchi of Tequesta, Fla., writes, "My wife Helen and I enjoyed very much to be with you and your Helen at the 60th reunion. The committee did a great job of coming up with such an interesting program. **Jerry Gardner,** the committee chairman, is to be congratulated, and I am sure, as president, he will be a good leader of our class for the next five years. Glad to know that your eye surgery was successful, and I am most pleased that you have agreed to carry on as class secretary. Helen had a knee replacement three days ago and is walking a little each day with the aid of a walker. Thanks for your birthday greetings on my 83rd. Helen joins me in sending our best to you both and all our classmates."

Lt. Col. **George A. Crandall** of Casper, Wyo., whose death was reported in the last issue of the *Review,* served as an industrial engineer for the U.S. Rubber Co. after graduation and worked in the construction field. Having taken advanced ROTC, he was one of the first in line to be called to head CCC Camps in 1933. After a few years in the Eastern camps, he was assigned to a new CCC project in Casper, Wyo. He was named camp commander. Living in Wyoming, Crandall was introduced to the life of fishing and hunting, and he succumbed and fell in love with the environment. He was about to purchase a sporting goods business when Uncle Sam beckoned again. In spring of 1941, the army needed officers, so Lt. Crandall went into service but not before he took an option to purchase a sporting goods store. Five years, after serving at Guadalcanal and other South Pacific trouble spots, Lt. Col. Crandall was back in Casper to exercise his option. It was a coincidence that my good friend and classmate, **Robert S. Pride,** whom I have known since high school days, landed in Crandall's unit. At the age of 51, he married Willa Millard, a Casperite, and she brought Crandall four additional pleasures, two sons and two daughters by a previous marriage. George attended our 45th reunion with his wife, Willa, where I met them for the first time. They were also present at our 60th reunion at MIT together with Robert Pride and his wife. It was ironic that he died two weeks after he received my birthday card while on a fishing trip.—**Karnig S. Dinjian,** secretary, P.O. Box 83, Arlington, MA 02174, (617) 643-8364, winter (407) 395-2890

30 60th Reunion

For the class of '30, 1989 was notable for its 50th wedding anniversaries and 80th birthday parties. We have two such events to report this month. Last October 28 Margaret and **Ted Riehl** celebrated their golden wedding anniversary at the Tucson National Resort with a gala party hosted by son Charles, son John (PhD '66), and daughters-in-law Kristi and Linda. Louise and I made our usual autumnal transit to our winter home south of Tucson and arrived in time to help the Riehls celebrate.

During the course of the evening Ted and I were able to find a few minutes to discuss class affairs. From this and other sources, there are a number of items to report. As you have probably learned, **Dave (Tul) Houston** has accepted the responsibility for raising funds for our 60th reunion gift, and preliminary reports concerning his efforts are encouraging. . . . **Jack Bennett** has taken on the job of nominating chairman, and will put together a slate in June. . . . **Ed Kingsley** has asked to be relieved of the treasurer's job for health reasons, so Ted will take over until a new treasurer is elected in June.

John Scheuren's 80th birthday party in August was arranged by his "number one" son Frederick and daughter-in-law, Elizabeth Lam Scheuren ('74). It must have been quite a bash. Those attending included the Scheurens' seven children, 11 grandchildren, numerous nieces and nephews, and many old friends. The Scheurens took over the Hingham Community Center for the event. Several hundred relatives sent in cards. One offbeat gift came from John's sister in Virginia—a few cases of Mosel wine from the village of Scheuren-ober-Mosel in Germany. Another birthday gift he received was a section of a U.S. Department of the Interior map showing the site of a proposed Antarctic aerodrome and a small nearby stream labeled "Scheuren Str." (As previously reported, while John was working for Metcalf & Eddy, he did extensive work in the Arctic, including an Air Force base in Greenland and part of the DEW line, as well as a preliminary study for an Antarctic air base.) Also included in John's report were photos of the Gasthaus Zur Waldeslust, Scheuren ub.Rheinbach, Germany. The correspondence and mementos were collated in two volumes entitled *Das Buchs.*

Last October at the annual meeting of the American Association of Blood Banks in New Orleans, **Jack Latham** received the association's Morten Grove-Rasmussen Memorial Award. The accompanying citation reads: "For his pioneering technological contributions to the design and development of a rotating disposable bowl, the 'Latham Bowl,' which allows separation of red cells, white cells, platelets, and plasma in a closed system. He is recognized as the undisputed father of modern clinical separation and cell processing technology." The highlight of the evening for Jack occurred just as the affair broke up, when "a young man pushed his way up to me to shake my hand and tell me that six members of his family had been treated for leukemia at the M.D. Anderson Hospital in Houston, and each one of them had received platelets collected with the Latham Bowl."

As a final item, when the MIT chapter of Phi Gamma Delta celebrated its 100th anniversary in 1989, the oldest participating celebrant was our

classmate **Morrell (Hijo) Marean.**—**Gordon K. Lister,** secretary, 294-B Heritage Village, Southbury, CT 06488

31

I'm having a hard time putting much together, as I have heard very little from you. If you are anything like me, the first place I turn to when the *Review* arrives is the class notes. It is very interesting to know how well you are getting on as "retired" individuals.

Last October 26, I attended a meeting of the local SAME chapter, and who showed up but **Edward Norris** and his wife. Both are in good health. Though Ed is retired, he tells me he still gets calls to survey lots, and he seems to enjoy doing some of it. We both attended Civil Engineering Summer Camp at Gardner Lake in 1929 and have fond memories of it. Regrettably, the Institute sold the 800 acres years ago, and I understand the *Quoddy Times* has recently reported that it is now owned by a developer.

The *White River Valley Herald* has reported the demise of **William K. Backli,** Course VI-A, at his home in Randolph, Vt., on August 25. Bill had a varied career—several years with General Electric, then to Stowe to operate a vacation lodge, Trails End, then started an electrical contracting business for 20 years. He then moved to Randolph where he worked as an engineer for Dubois and King and taught a short time at Vermont Technical Institute. His wife, Margaret Fenley Jones, whom he married in 1939, survives him. Our sincere condolences to her.

Somewhat belatedly, I learned that **John "Jack" Woodbury Lane** was presented with the NLGI Spokesman award at the 55th annual meeting banquet of the National Lubricating Grease Institute on October 25, 1988. He was employed by the Franklin Motor Car Co. (remember it?) from 1930-1932 and was a mechanical engineering instructor at MIT from 1931-1932. Then he was a field engineer for Socony Mobil and Mobil Oil until he retired in 1974. He was a consultant to C.R.D. Total France from 1976-1987. He served on the board of directors of NLGI from 1952-1986 and as president from 1956-1957, and had received a number of other awards. He now resides in Crestwood, Tuckahoe, N.Y.

On October 6-7, I attended a reunion in Lexington, Ky., of the outfit I was assigned to in 1941, while I was serving a one-year active duty call. This was extended for four more years on December 7, 1941. Had a most interesting time recalling incidents on the Alaska Highway pioneer road and with the Third Army.—**Wyman P. Boynton,** secretary, 668 Middle St., Portsmouth, NH 03801

32

What does one do after reaching 70 years of age and retirement? Sit in a rocking chair on the porch waiting for meals to be served? Not **G. Robert Klein.** Bob, retired chairman of the board of the family-owned George R. Klein News Co., says, "I keep myself over-committed."

With a businessman's eye for the "numbers," Bob reveals that this year he belongs to 25 boards, subscribes to 34 magazines, has attended 55 plays (15 in London, 10 in New York, the remainder in Cleveland), listened to 24 Thursday night Cleveland Orchestra concerts, read 2,000 pages of minutes and memoranda as a Musical Arts Association trustee, funded four scholarships at Cleveland State University, visited France to see 48 U.S. high school bands celebrate the Fourth of July at Versailles, and every two or three months buys the top five books on both *The New York Times* fiction and nonfiction best-seller lists so he can read at least one book a week.

That balance sheet does not include his fund-raising records: $34 million for the Ohio Wesleyan



Robert Klein, '32

University's endowment, $17.5 million for St. Luke's Hospital's development fund, $15 million for the Musical Arts Association endowment, and $5.8 million for the Cleveland Institute of Music's $8.8 million capital campaign.

Bob, keep up your good work. You are an inspiration to your fellow classmates.

We heard from **Tom Weston,** who is as active as ever. He wants us to have a good get-together, a mini-reunion for Technology day in June 1990. Yes Tom, there will be special activities for us at that time. **John Brown,** our president, will announce the program soon. . . . I talked to **Benjamin Wilbur,** who retired from General Electric when he was 60. He and his wife are in good health. He likes working around the house and refinishing furniture. . . . **Norman Schulze** is hale and hearty. He promises to give me a visit sometime soon.

Charles Spiegal and his wife attended the September Alumni Leadership Conference. They proudly announce their new (and third) great-granddaughter. They have seven grandchildren, offspring of their four children. Can anyone top this record? . . . **Willem Holst** has lived an active life. He was an engineer and an economist for the petroleum industry. He also served as a consultant to the President's Science Advisory Commission on the World Food Problem. Although he is retired, he is still busy as a financial advisor. He lost his wife Margaret in 1986 and in 1988 remarried Mary, who is active as a consultant in the software computer field. Willem and Mary are combining their experience and talents and are developing a software program for evaluating Mutual Funds. . . . **Al O'Neil** had an accident that hurt his back in March 1988. After a long period, he has recovered. He keeps busy with his yard and summer trips. He enjoyed Lake Placid immensely.

Fellow classmates, write me, send pictures. I don't want to write obituaries only (none in this issue).—**Melvin Castleman,** secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

33

Mighty little to report in volume but rather interesting in content. **William A. Gray** of Charlottesville, Va., writes: "Mr. Rogers tried to organize the Institute as a part of University of Virginia. Rejected by the legislature at Richmond, he, with the help of Mrs. Rogers and her Boston friends, did succeed in establishing MIT in Boston. In commemoration, I have the Virginia license plate 'MIT 33,' a feature studiously ignored by the natives."

Ralph Cross made a major gift to MIT in establishing the Ralph E. and Eloise F. Cross Professorship of Manufacturing Technology. All of us who had anything to do with the machine tool industry know Cross and Trecker as one of the best in the business. Ralph has been instrumental in the following MIT activities: Laboratory for Manufacturing and Productivity, 18 years on the Corporation Development Committee, Visiting Committee for mechanical engineering and the Corporate Leadership Award of 1976.

Ralph and Eloise have retired to 4120 Shelldrake Lane, Boynton Beach, FL 33436, (407) 734-0657.

Robert Whitton, son of **Beau Whitton,** 5100 Sharon Rd., Apt. 319, Charlotte, NC 28210, reports that Beau is slipping but is responding occasionally and would love to hear from classmates.

Maybe some of you have seen the following, but I thought it pretty clever. While visiting one of my children in Lexington, Ky., I saw a sweatshirt in a bookstore with large MIT emblazoned on it, so I did the obvious. When I got very close, what I saw was MIT (in very large letters) "prides itself on being the *vpi* of the north" (in appropriately small letters). So we may have the pretense to claim all the brains, but we sure don't have the sense of humor to match that one.—**William B. Klee,** secretary, P.O. Box 7725, Hilton Head Island, SC 29938, (803) 785-7746

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Once more I have only unfortunate news to pass on: more losses in our ranks. The earliest, in point of time, was that of **Reginald Murdock** on May 14 in Laconia, N.H. Following his graduation in marine engineering, he went with Texaco, the start of a 40-year career with that company. Having a reserve commission in the Navy, he was called to active duty prior to Pearl Harbor and assigned to the Bureau of Ships. He spent his war service overseeing some 16 shipyards in Maine and was discharged as a lieutenant commander in 1945. He then returned to Texaco and served in the Marketing Department in the northeastern part of the country and in Europe. Mr. Murdock is survived by his wife, two sons, and two grandchildren.

On May 31, **David Knox** died in Stonington Conn. He had been a civil engineer and land surveyer and had practiced for many years in Haiti and South and Central America as well as this country. Mr. Knox leaves a brother and three grandchildren, his wife and son having predeceased him.

Here on Cape Cod, **Harry H. Hallas** died on August 13 in Sandwich, Mass. He had received a bachelor's degree from Boston University before coming to MIT for additional study. Consequently, he was a member here on the Cape of both the BU Alumni Club and the MIT Club. At the time of his retirement in 1975, he was director of plant operations at the Brookline Hospital. Mr. Hallas had been a longtime summer resident of the Cape and had lived in Sandwich since his retirement, where he was active in civic affairs. He is survived by his widow, Mabel, two sons, a sister, and two grandchildren.

My last item will be a real shocker to any of us who have been active in class affairs and reunions. On November 5, **Walt Wrigley** died in Wollaston, Mass. He had been our class president for at least ten years and was just re-elected to a third term at our 55th reunion last June. Thanks to a phone call from **Larry Stein,** I was able to be one of six classmates who were able to attend a memorial service in Quincy on November 9. **John Hrones,** our first vice-president, has agreed to take over as class president.

Walt had occupied a position of eminence in his profession, both as a teacher and as an innovator in the field of gyroscopics and inertial guidance navigation systems. He was closely associated with Stark Draper and the Draper Laboratory, especially during the years when it was a part of MIT. (For more career details, see Obituary section.)

In looking at Walt's 50th reunion booklet entry, I realize that we had identical attendance records at reunions; this is really the way I got to know him. And, of course, since I moved to the Cape, I've seen him and Dorothy a number of times at Tech affairs.

A few years ago he was a member of an aeronautical engineering group that was officially invited to China. It was on this trip, I believe, that he was able to revive contacts with **Wing Lem Wu.** After this contact, any classmate going to

China was encouraged to see Wing, which culminated in our being able to bring him to our reunion last year.

Over the years, Walt had been active in Masonic affairs in Cambridge, had served as a judge for the North Quincy High School Science Fair (from 1961 to 1989, missing only two) and was active in the United First Parish Church in Quincy. He was a quiet, unassuming, friendly man; we will miss his presence in the future. Walt is survived by his wife Dorothy, a son and daughter, a sister and brother, and four grandchildren.

To the families involved in this unfortunate litany I offer sympathy from all the class.—**Robert M. Franklin,** secretary, P.O. Box 1147, Brewster, MA 02631; **George G. Bull,** assistant secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

35 55th Reunion

November 4 was the date of the big picnic of the MIT Club of San Diego, and I had a surprise visit from **Jack Holley** and his wife, Lenora, on their way to the affair. I was delighted to see Jack again and to meet his lovely wife. Then on November 10, I attended a reception at the Knoles Gallery of La Jolla for **George Kylos** who was presenting his 28th one-man art show. George started his painting while he was studying architecture at MIT. His paintings, mostly watercolors, were fascinating and beautiful. We are meeting for lunch in a couple of weeks, and I shall have more personal history for the next notes. He was knee deep in adulating fans and had little time to talk there.

Lester H. Moffatt, Fort Worth, Tex., reports that he is happily married 44 years to lovely Sue-Jo. They have two children, Hugh and Katy, who are talented, successful singer-songwriters in country music, and two adorable grandchildren, Lagan and Corianna. His hobby/enterprise is design/development of unique recreation vehicles. He published a book on personal financial planning for retirees during inflation.

Sam Brown writes from Punta Gorda, Fla., that they will be going to Europe again just before or after our 55th. Last summer was so rainy in the Poconos that they played golf only a few times. They are looking forward to playing at Kingsway CC with its wholly rebuilt new greens. **Bob Lindenmeyr** in a letter to Sam reports to be in fine health, with his golf active but suffering from the higher scores that all of us oldsters seem to experience. Three of Sam and Natalie's grandchildren now are at college with three more to go in the next two Septembers. Sam says, "I do hope that I live to see some of them graduate." Knowing Sam, I'm sure he'll be around to see them with advanced degrees.

Wes Loomis wrote to me of **Peter Grant**'s death last October 2 just too late to get into the notes last month. Wes said that it was a blessing for Pete who had been suffering from a respiratory condition that restricted all his activity for the past five years. His son Jonathan and wife visited Pete and Jane last summer, and his son G. Peter and Jackie were there to celebrate his parents 50th anniversary. Pete was a member of Phi Gamma Delta and rowed on the 150-lb. varsity crew. He established Grant Photo Products, of which he was president. After selling the company to Amsco, he became director of Alumni Clubs for the MIT Alumni Association. He was past president of the Alumni Association and was awarded the Bronze Beaver in 1975. He is survived by his widow, Jane, and his two sons and their wives. His home was at 1910 Morris Ave., Sarasota, Fla. I extend the sympathies of all of his former classmates to Jane, her sons, and their wives.

Bernie Nelson began his 10-day trip at the end of September so he could not be reached with the news of Pete's death. He drove 900 miles, spending three nights with the **Don Gittens** on Long Island, had dinner at the top of the Pan Am Building in New York City for retired officers and department heads of the New York Telephone Co., stayed with his daughter Betsy Duenes in New Jersey, continued on four days later to visit relatives in Albany, then toward home through Bennington and Fitzwilliam, N.H. **Henry King** and **Bob Lindenmeyr** joined Bernie for a "grand bull session" a week after he returned.

Ann Cross reports that they will be missing the 55th because Bill is not well. They are living at the Charter House, a retirement home near the Mayo Clinic, which happens to be where my sister Annette Ransom is. Bill has a nice room on the 4th floor with skilled nursing care. . . . I talked with **Ned Collins** who is laid up with blood poisoning in his foot but hopes to be up and around soon.—**Allan Q. Mowatt,** secretary, 715 N. Broadway, Apt. 257, Escondido, CA 92025

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In New Jersey again, for the 50th wedding anniversary of some old friends and tennis partners, I had another opportunity to cruise nearby and visit classmates.

George Robinson (Course X and SM, Course XV, '37) and wife Virginia are in good health and enjoying his second retirement, this time from 18 years as business administrator of Clark Township. George has given 40 years of service to the town in all manner of activities: board of education, youth counseling, scholarhip fund, historical projects, and interviewing freshman applicants to the Institute. He was honored in 1978 for distinguished service to the community, of his 1981 "retirement" the local newspaper wrote the headline: "Adieu, Not Goodbye, Mr. Robinson," and the editor added a personal note of thanks for consultations on matters of importance to the town. At one point during his years with Union Carbide, George was on a project at St. Martin Island, and with three Dutch friends bought a property and built four rental units on a local government pledge of no taxes for 10 years. The pledge was abrogated and the project barely broke even, but "it was fun while it lasted." George and **Dick Denton,** both from Wakefield, Mass., high school and in Course X at Tech, have kept in touch and visited in New Jersey, Martha's Vineyard, and Florida.

Rudolph Ozol followed his Course X leanings for about 20 years with Standard Oil in Bayway, and then established his own business in security brokering. He continues fully active at his office in Linden, N.J., with wife Ida assisting. He recalled his senior thesis at the Institute, a joint project with **Henry McGrath** and the late **Jim Vaughn,** to improve the yield in the refining process of amyl alcohol. It didn't work, but Professor Gilliland gave good grades for the attempted method—except for Rudy, whose part concerned the economics. As he tells it now, the prof was not very impressed with Rudy's analysis, but he passed him. Rudy was captain of the fencing and golf teams, and continues with golf and amateur photography. He is past president of the New Jersey Federation of Camera Clubs and still judges competitions. He is a long-time member of the Northern New Jersey MIT Club and serves on its board of directors.

Henry Wilsey (Course VI-C) and wife Janet recently celebrated their 50th wedding anniversary in Weekapaug, R.I., with 39 guests lodged there and nearby. They remember our 15th reunion at Weekapaug Inn and hope we will be there for the 55th. Henry keeps in touch via ham radio with Roger Albiston, '37, who was their best man. He remembers being interviewed for a job in 1937 by **Harry Pekin** (also VI-C) at Tungsol Electric, but went with Underwriters Laboratories. In 1944 he joined Western Electric-Bell Laboratories, and in 1946-1947 worked on airborne radar in the same department as **John Hibbert, Harry Foster,** and **Jack Cook.** As noted in the 1989 May-June issue, he is very active in the town of Upper Montclair, N.J.

Marcus Warmuth is seriously incapacitated but at home in Wyckoff, N.J. He retired from Englehard Minerals in 1985, after a series of jobs—Rohm & Haas in Texas and others—"riding herd on contractors to get jobs done per contract and on time." He remembers **George Ray** from Course XVI, and talked about three classmates entering the Institute from the same senior class of Montclair High School: **George Hain, Henry Wilsey,** and himself. Marcus requires an oxygen supply much of the time, but enjoys visits.

I reached **Joe Chenette** (Course I) in Ridgewood, N.J., by phone, but since our schedules conflict, I hope to get an item from him by mail. . . . **Hans Lang** a graduate student in Course II, was not at his Lang Associates business in Tenafly, N.J. His son-in-law there said he spends much time at his Easthampton, Long Island, home.

Earlier last year I photocopied a 1933 picture of our freshman 150-pound crew to send to **John Easton**'s daughter Pamela, and while at it, also sent copies to other members whose addresses are known: **Gordon Thomas** (stroke), **Slim Beckwith, Rob Wead,** and Al Whitcomb, '37. Gordon replied from their vacation place in Quebec: "You blew me away when I opened your letter and found the crew picture—how did you get it? I'm not sure I ever knew of its existence." . . . From Rob in Hawaii: "Thanks for the archival photo of us young guys and our sweeps. I can recall the ice forming between my hands, and also how sacred an obligation I felt to show up. . . I'm making our '91 reunion my dream and priority." . . Slim called his appreciation and provided information on classmates in the San Diego area, whom I hope to visit this winter. . . . If any readers have group pictures from student days to share with other classmates via photocopy, I can provide up-do-date addresses from the latest computer printout. Drop me a card or call at Saturday low rates—(505) 988-2745.

Writing these Notes two weeks after the earthquake, the San Francisco area is much in mind. We have about a dozen classmates living thereabouts, and we hope all are well. I reached several by telephone, all of them unharmed, and their reports were upbeat: **Boris Maximoff** (Course VI-A) in Los Altos had four broken dishes, and one-third of the water sloshed out of his swimming pool. . . . **John Myers** (Course XVI) in Redwood City had no damage, and Jeanne's electric iron survived a fall from the ironing board. . . . **Luis Emilio** (Course II) in San Leandro, seven miles nearer the epicenter than the collapsed freeway in Oakland, felt his chair shake for about 15 seconds, but there was not even one crack in the stucco exterior of his home. . . . **Al Horton** (Course XV) at Oakville in the Napa Valley, north of San Francisco Bay, felt nothing. (His speech is slightly slurred from a stroke while traveling in Europe last fall and visiting Gabriele's relatives in Germany. But his spirit is great and he wants me to visit their area.) . . . **Bill Hewlett** (Course VI) was not available on the telephone, but on my second call his secretary said that he was fine and suffered no ill effects.

Assistant Secretary **James "Pat" Patterson** reports unusual attendance at the mini-reunion October 28, which augurs well for interest in our 55th: **Fred Assmann** and Mary, **Herb Borden** and Kitty, **Towers Doggett** and Doris, **Phil Gilinson** and Hulda, **Eli Grossman** and Vivienne, **Alice Kimball** and daughter Martha, **Augie Mackro** and Virginia with son Jay, '71, **George Parkhurst** and Barbara, **Pat Patterson** and Marian with daughter Marcia, **Mike Tremaglio** and Edith, and **Milner Wallace** and Robin. Pat's items of interest will appear in the next issue of Notes. . . . George Parkhurst has agreed to chair the Cambridge portion of our 55th reunion, and we feel assured that he will work to increase the attendance of nearby classmates, which barely equaled California's numerically and percentage-wise, at the 50th.—**Frank Phillips,** secretary, 901 Los Lovatos, Santa Fe, NM 87501, (505) 988-2745; **James Patterson,** assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

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News from the class of '37 is sparse. I do not know whether it's because you are all so tired that you cannot write or because life is so dull that there is nothing to write about. I would hope that preferably you are all so busy that you simply do not have the time. I would be most grateful for news. If any of you write a Christmas, Seasons Greetings or New Year's letter, I would be most grateful if you would send me a copy editing out any information you do not think is pertinent or you do not wish published.

Pearl and I spent last winter at La Jolla, Calif., and had a great time. As most of you know, the climate is delightful with flowers blossoming throughout the year. On many days the winter is warm enough to go swimming. We joined the Institute of Continued Learning at the University of California, San Diego campus. Membership permits us to take regular courses at the university, and we took two courses in addition to attending many events at the institute itself. Pearl's oldest daughter Sue got me interested in computers, and I ended up with a COMPAQ unit and a microsoft word processing program. It has been fun learning to use the computer, including good chess and bridge games. My daughter Martha changed jobs as a personnel recruiter for MA/COM to a similar job with Marshall's Discount Department Stores. Her oldest son is working in Boston.

Pearl and I have been considering retirement communities and actually signed up for a future slot at North Hill, a non-profit retirement community in Needham built on land leased from Babson Institute in Wellesley (adjacent to Needham). We were offered an efficiency unit last year but were holding out for a one- or two-bedroom. In the meantime, Genevieve and **Leonard Seder,** who were also on North Hill wait list, decided to go into another unit at Brookhaven at Lexington just completed last October. They moved in mid November. At Genevieve and Leonard's urging, we finally decided to give up North Hill to move to Brookhaven at Lexington December 7, 1989.

Fred Altman, Arlington, Va., retired from Cybercom as a senior scientist on December 31, 1988. He prepared two papers for IGARSS presented in Vancouver in July 1989. His hobbies are hiking and square dancing, and he assembled an AT/PC with a scanner. He visited France twice in 1988 and the English Lakes in 1989.—**Lester Klashman,** secretary, Brookhaven at Lexington, 307A, Lexington, MA 02173

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Arch Copeland, who retired from Revere Copper & Brass in 1977, writes that he and JoAnn are enjoying life in rural Arkansas. Although there is only one other MIT alumnus in Heber Springs, Arch does write of plentiful wildlife: coyotes, deer, and bald eagles, among others. He is able to keep in touch with the greater Boston area and MIT in particular through his niece, Anne Womack, and her husband Jim. Anne is employed at Boston University's Clinical Psychology Department, and Jim is in charge of the International Motor Vehicle Program at MIT's Center for Technology, Policy, and Industrial Development.

We have a long letter from **Al Clogston,** who "retired" in 1982 from Bell Labs to Tesuque, N.M. (in the Santa Fe area). Although he has had little contact with classmates—especially since few of us went into physics in those days—he keeps in touch with MIT and its graduates as a result of his dozen years at the Institute and 36 years with Bell Labs. I'll not attempt to detail Al's professional career and service on national committees, boards, and councils. To do so would leave little space for notes from other classes. After earning an SB and then a PhD (1941) at the Institute, he spent five years with the MIT Radiation Lab, where he headed research on magnitrons. From there he went to Bell Labs for a distinguished career, including head of several labs and departments. He later became vice-president for research at Sandia National Lab, and then returned to Bell Labs as executive director of physics research, the division that gave birth to the transistor, the laser, the semiconductor laser, and light-emitting diodes.

Al's "retirement" first included consulting for Los Alamos National Lab, then organizing a center for materials science at Los Alamos, where he is still employed. Since becoming a member of the National Academy of Sciences in 1973, he has served on many and varied committees, recently including the academy's Council and Executive Committee and the National Research Council's Governing Board. Al also has published numerous technical articles, has been granted 14 patents, has actively participated as a fellow of the American Institute of Physics and the American Physical Society, and has served on the Air Force Science Advisory Board. Al still finds time for Santa Fe's various community activities, especially the Science Board of the new and burgeoning Santa Fe Institute, an endeavor devoted to the behavior of all manner of complex systems from neuroscience to global environment. Although all this has left little time for travel, he and Molly do get to Virgin Gorda every February and plan a European trip for 1990. Molly, in turn, is busy with the Santa Fe Opera and the Wheelwright Museum of the American Indians. Of their two daughters, Nancy is a high-level computer systems manager, and Carole, a successful trial lawyer.

Let's hear from some more of you. In the meantime, **Ed Hadley** will be writing the next column of 1938 Notes.—**Don Severance,** secretary, 39 Hampshire Rd., Wellesley Hills, MA 02181; **Ed Hadley,** assistant secretary, 50 Spofford Rd., Boxford, MA 01921

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A Presidential Citation Award, the highest the MIT Alumni/ae Association can bestow on any of its organizations, was presented to our class at the annual awards luncheon last September 23. Our class was recognized as a model 50th reunion class. The certificate reads: "By establishing new connections between fundraising and reunion planning, the 50th reunion and reunion gift committees were able to achieve record-breaking participation in both the reunion and the gift. The 50th reunion for the MIT Class of 1939 has set new records for dedication and energy, an inspiring example for reunion classes to come."

Attending the luncheon and accepting the award on our behalf were our class officers: **Seymour Sheinkopf,** president; **Ernest Kaswell,** agent and past president; **Oswald Stewart,** vice-president; and **George Beesley,** past president.

The Harold E. Lobdell, '17, Distinguished Service Award, given in recognition of valuable alumni relations service of special depth over a sustained period to the Institute and/or its alumni/ae assocation was awarded to **Ernest Kaswell.**

A desk clock inscribed with the title of the award and Ernie's name was presented to him "for fundraising activities, MIT Class of 1939 Reunion Committee efforts, loyalty to MIT and quiet support for the MIT Alumni/ae Association.

Dick Myers writes from Mansfield, Ohio: "Thanks for suggesting I contact **John Alexander** and **Sam Sensiper** to share our mutual interest in ham radio. About four years ago, I felt the urge to contact four special friends from MIT undergraduate years: **Fred Mulberry, George Laurent, Latimer MacMillan,** and **Charles MacArthur.** I found them all, enjoyed letter and phone contacts with them, and that resulted in their all coming here to visit Betty and me. In fact, Fred was here twice. It is regrettable that both Fred and George passed away in 1988.

"After track, cross country, and 150-pound crew at MIT, I jogged for years until Ohio winters drove me indoors to a rowing machine. Lord knows there is lots of exercise in maintaining our 15 acres here. I was sorry to miss our reunion, but our horses, dog, and all the orchard and garden activities during late spring made a reunion trip impractical. We appreciate the class notes—I always go for them first when the *Review* arrives. The best of continuing good health and life's good things to you and our mutual friends."

Jim Barton relays news of the engagement of **Bill Murphy** to Anne McGeoch. All the best to two nice people in Clearwater, Fla.!—**Hal Seykota,** secretary, 1701 Weatherswood Dr., NW, Gig Harbor, WA 98335

40 50th Reunion

Richard Babish, reunion committee chairman, reports that everything is well under control for us to have a real bang-up reunion next June. By now, you have all received your questionnaires, and, I hope, completed and returned them for inclusion in the reunion book. You have also probably received your order form for the red jacket to wear at the commencement procession, the banquet at Mystic, dinner and Pops at Symphony Hall in Boston, and at Technology Day. Details of events and activities to be available at Mystic are still being finalized by the committee.

Unfortunately, it is necessary to report that **H. Garrett Wright** passed away on November 14, 1989. Garry had been looking forward to being with us next June, but it is not to be. I have no further information now, but expect to have more for the next issue. . . . In addition, **Rafael Martinez** of Guaynabo, P.R., died on April 5, 1989. From Frederick Grant, '39, I have obtained some information about Rafael. He served in the Navy during World War II, and thereafter he joined the family business operating a sugar plantation. When government regulations and a restrictive labor market made that an unprofitable business in the '60s, he turned to land management and the sale of portions of the property. In the late '60s, he became a director of Scotia Bank of Puerto Rico, a subsidiary of the Bank of Nova Scotia. He retired from that position in 1970. We send our condolences to both families.

Class Treasurer **Edgar Bernard** sent some statistics on class membership. From our original class of approximately 600 members, we currently have information on 436 members. Of these, 44 percent have paid their class dues through 1990, and another 11 percent are paid up through 1989. Please send in your checks to Ed so he can close his books before the reunion. This will also enable him to budget requests from the reunion chairman for support of his plans for the 50th. Ed also states that we had an attendance of 66 class members at the 45th reunion. We expect a much larger turnout next June!

There are four members of the class for whom we have no current information. They are: **Dave L. Mowrer, Jr.,** Kansas City, Mo., **Jason M. Rogers,** McHenry, Ill., **Frank Vos,** Stamford, Conn., and **G. Bruce Wooley,** Bahamas. If anyone has further data about any of these people, please let Ed or me know so that they can receive the notices about the reunion.

The latest figures on the reunion gift, as of October 28, 1989, show a total received and pledged of $2,936,00 towards our goal of $4,500,00. This comes from 288 donors. The November letter from **Ty Marcy** and the reunion gift committee spells out some of the ways to contribute and the fact that pledges for the next five years all add to the gift total. Each of us should help to educate today's youth by expressing our appreciation to MIT for the fine education we all received 50 years ago!

I had a telephone call from **David R. "Beano" Goodman** to talk about the reunion and to arrange to sit together at Pops. Beano is still working at his company, Madison Chemical Co., Inc., Madison, Ind., with his son. He is looking forward to coming East next year and seeing many

of his old friends again.

I look forward to messages from you, so that they may be included in future issues of class notes.—**Richard E. Gladstone,** secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

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John F. Sexton, class of '41 president, called a meeting at the Faculty Club to get going early on planning a 50th reunion. **Mitchell J. Marcus, Edward R. Marden,** your secretary, and Eliza G. Dame of the Alumni office were present. **Johan M. Anderson** attended a first such meeting. **John Sexton, Leona Zarsky,** and I will check out Chatham Bars and the Wequassett Inn. We would be most happy to get your input to make our 50th special.

Nathanial Rochester writes that to escape the New England March Blahs, fog, mud, and freezing rain, Nat and Louise keep their 40-foot ketch at **Ralph Delano's** house in Ft. Lauderdale. Nat says, "He has room at his dock for three sailboats. One he sails, one he charters, and the other one is ours. We arrive in mid March when the water temperature is reliably high enough for us to swim and the wind slacks off a bit. By mid May, it is too hot for a New Englander in south Florida, but spring has finally reached Duxbury, so we hop in our car and head north.

"Ralph is still the affable fellow you remember from 1941. He has a delightful wife, Connie, and they live in a beautiful house in a very good part of town. The boats are in the back yard, in a canal a short distance from the all-weather, all-season Port Everglades inlet. Ralph is very active in Power Squadron, the volunteer educational organization that makes it possible for electrical engineers like me, and lots of others, to become knowledgeable sailors. He has held about every important office and is now the head of education in the Ft. Lauderdale Squadron again. During the first two years of this, Louise and I spent our time living aboard our ketch and sailing in the Florida Keys. It was great. Next year we plan to spend our late winter and early spring in the Bahamas. Retirement is the best job either of us has tried yet."

There must be other yet undiscovered sailors among you; send your Jack London adventures to: **Joseph E. Dietzgen,** secretary, Box 790, Cotuit, MA 02635

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Please send news for this column to: **L. Kenneth Rosett,** secretary, 2222 Americus Blvd., N., Apt. 12, Clearwater, FL 34623

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Would you believe lots of news and no obits?

First, the MIT Corporation has honored two of our classmates: Colombian President **Vergilio Barco** and **Irenee "Brip" duPont, Jr.,** newly designated Corporation Life Member Emeritus. President Barco's citation reads in part, "for his couragious leadership of Columbia during a time of formidable challenge." Brip duPont was saluted for his many services and contributions to the Institute over more than a quarter century.

The case of the seemingly innocuous and facetious "meat and potatoes" letter of a few months ago has taken a sinister turn. An unamused **Dick Feingold** has disclaimed authorship, indignantly stating that he never uses the phrase. Barring the unlikely event of a confession from party or parties unknown, this bizarre incident joins the mysterious company of Amelia Earhart's final destination and Custer's last words.

Dick has also forwarded an announcement that **Victor Darnell,** a retired civil engineer, has compiled a "Directory of American Bridge Building Companies 1840-1900," printed recently by the Society for Industrial Archeology. . . . By way of **Jim Hoey** we learn that Cassandra Klouman, daughter of **Kemp Maples** and teacher at Chatham, Mass., Elementary School, helps her students play the stock market with an imaginary $100,000. Is this Kemp's source of financial advice?

Now for the first authoritative report on the Great South West California Florida Midtown Manhattan meeting in October. Hosts Sue and **Harry Ottinger** of Albuquerque (Albq in the local vernacular) welcomed an expectant group: Lenore and **Bernie Brindis** (Fla.), Sue and **Jim Malloch** (Calif.), Joan and **George Marakas** (Fla.), Marjorie and **Chris Matthew** (Calif.), Ros and **Jim McDonough** (Mass.), Susan and **Bob Rorschach** (Okla.), Ellen and **Jim Spitz** (N.Y.), Bunny and **Jack Tyrrell** (Ariz.), and Vicky and **Hans Walz** (Mass.)

Friday we checked into our roomy suites, tried to adjust to the mile-high altitude of Albq, and enjoyed complimentary cocktails in the hotel lounge. There we congratulated Chris Matthew on his designation as next president of the Alumni Association; gave our admiring regards to Jack Tyrrell, who valiantly attended while still recovering from a stroke; and started the warm camaraderie that was an outstanding feature of the entire five days. The climax of the evening was a delightful Mexican dinner at the hillside home of the Ottingers, commanding a spectacular view of Albq and surroundings. Much of the work in constructing the house was done by Harry and Sue with their own hands.

There are four more days to go, possibly enough for the next two editions of Class Notes.—**Bob Rorschach,** secretary, 2544 S. Norfolk, Tulsa, OK 74114

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Frank Carroll was in town for the Alumni Conference last September, and had a very enjoyable visit from **Lou Demarkles.** Frank has retired from the management of Decks, Inc., the largest roof-decking construction firm in the U.S. in the 1960s, 1970s, and 1980s. The company installed more than a billion square feet of industrial, commercial, and public roof decks between 1950 and 1989. Frank is switching now to licensing his patents and dreaming up new concepts in an effort to revolutionize certain areas of the construction industry. He and his wife Kathleen have fond memories of our 25th reunion, and are looking forward to meeting again with the class in the future.

We had a brief note from **Jay Kogan,** who tells us that he is a real-estate developer in Michigan. Jay's address in 19901 James Couzens Highway, Detroit, MI 48235. . . . We also received the sad news of the passing of **Alphonse Corona** on July 4, 1989. He started his professional career at Kellogg Engineering and later moved to Socony Vacuum Oil Co., where he continued his work in pressure vessel design and utilization. He later shifted to safety loss prevention activities and pioneered a new test to evaluate the level of protection that could be realistically expected from fireproofing materials. The test received worldwide acceptance and is now a standard method of evaluation. Al retired in June 1985, but remained active as a consultant to Mobil on matters concerned with safety and loss prevention. He received several certificates of appreciation for his work from the ASME, AIChE, and from the Central Jersey Engineering Council. We extend our sympathy to his widow Marilyn.—Co-secretaries: **Andrew Corry,** P.O. Box 310, W. Hyannisport, MA 02672; **Louis Demarkles,** 77 Circuit Dr., Hyannis, MA 02601

45 45th Reunion

Please send news to: **Clinton H. Springer,** secretary, Box 288, New Castle, NH 03854

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A Friends of MIT Sailing newsletter mentions sailboats that alumni have given the organization. One of them, a "420," was donated by our very own **Bob Fried,** a real philanthropist in every sense of the word. . . . **Jim Murphy** attended the 50th anniversary celebration of the creation of our Aeronautics Department. Bob, who has done very well in the field, was our only representative of '46. He writes, "It was a good program with a mixture of nostalgia and projections of future trends in the profession." Professors, **Otto Koppen** and **Rene Miller** also participated along with several others who "provided some interesting insights on the future of aero/astro technology." Bob also notes, "The Grad House looks the same, but the athletic facilities have greatly improved (boat house and new playing fields). The students projected a very positive image of MIT and the environs."

Have a good one, wherever you are!—**Jim Ray,** secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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We'll start this month with a long, newsy letter from **Hugh Flomenhoft.** (Yes, Hugh, I *did* receive it, but Murphy's Law affected the publication date. The letter arrived right after one deadline and we missed the next deadline because of a trip to the United Kingdom—but better late than never.) Hugh retired from Raytheon's Missile Systems Division in September 1989, and he and Lori moved to Palm Beach Gardens, Fla. After six months of "settling in," they left for six months in Europe. First, they toured Israel (a visit to the Children's Memorial at the Holocaust Museum left the deepest impression). Hugh came away with a feeling that the Palestinian problem may have no solution because "Israel cannot afford to give up anything, yet something meaningful must be done for the Palestinians." After Israel, they spent six days in Egypt and then traveled to the U.S. Air Force base at Ramstein, West Germany. There, Hugh was a visiting professor in Boston University's Overseas Program for the summer semester. He taught linear algebra, numerical methods, and structural dynamics to students (mostly Air Force pilots) seeking a master's degree in mechanical engineering. Hugh reports that it was a very satisfying experience, although it was not easy teaching subjects (in which he was rusty anyway) out of new textbooks! While he was thus absorbed, Lori worked as a voluntary speech therapist at the elementary school at the army hospital in nearby Landstuhl.

Claude Brenner is always a good source of information—thanks, Claude. He reports that the Department of Aeronautics and Astronautics celebrated its 50th anniversary last September. The affair lasted two days and more than 200 alumni, alumnae, and guests attended. As the largest class ever graduated from the department, the class of 1947 was well represented. In alphabetical order, '47 attendees were:

Claude Brenner, of course. Claude is our class president, and is president of Commonwealth Energy Group (a consulting organization) in Lexington, Mass. Hugh and Lori Flomenhoft came back from Europe via Cambridge to attend. **Vince Haneman** attended with his wife, all the way from Fairbanks, Alaska. He is dean of engineering at the University of Alaska. **Phil Labombarde** (retired) came from Nashua, N.H. **Bill Reece** attended from Ithaca, N.Y. Bill retired from National Cash Register after 26 years as a printing engineer, and is now a full-time consultant with Borg-Warner Automotive. **Dick Scheuing** came with his wife Doris. He is vice-president and deputy director of Corporate Technology at Grumman Corp.; they live in Cold Spring Harbor, Long Island. Fran and **Phil Solomon** paused at the reunion before sailing their 40-foot sloop from their summer home in Yarmouthport,

Mass., through the inland waterway to their permanent home in North Bay Village, Fla. Phil spent his career as a flight engineer with TWA. He was also trained as a pilot and often flew as a reserve pilot on the longer 747 international runs. He retired last year. Last but not least, Jane and **Howard Zwemer** came up from St. Michaels, Md. He retired recently after many years as a senior research engineer in operations research for the Air Force at the Pentagon. He still does some consulting in the Washington area.

Harold Brown made the *"Forbes 400"* in the September 23rd issue. *Forbes* estimates his net work as "well over $500 million," and comments that that "beats metallurgist's wages." (Harold studied metallurgy at MIT.) Still quoting from the *Forbes* article, Harold started a doughnut chain after World War II and was then recalled to Korea in 1950. Afterward, he bought a six-unit apartment building as a sideline in 1956, thereby discovering real estate. By 1970, he concluded he had to either quit his job or sell his real estate; he stayed with his real estate. His Hamilton Realty Co. now controls approximately 6,000 apartments, and 9.1 million square feet of commercial space in the Boston area.—**Robert E. McBride,** secretary, 1070 Pilgrim Pky., Elm Grove, WI 53122

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At a meeting of class officers in October, we reviewed the responses from a mailing to all classmates. The 75 classmates who responded expressed more interest in our 45th reunion in 1993 than an off-year reunion in 1991. The responses also supported plans to have the 45th on campus at MIT in June 1993.

There is sufficient interest in a 1991 reunion to support proceeding with plans. We have reserved the Harborview Hotel in Edgartown on Martha's Vineyard for September 22 and 23, 1991. Edgartown has a variety of activities including most sports, a variety of shopping opportunities including crafts and paintings, several unique scenic locations including Gay Head, and a number of historical buildings. The hotel has complete facilities for a leisurely weekend. The ocean warms up during the summer, and in September the weather is often delightful. Also, we have invited classes of '47 and '49 to join us, and they are interested in planning a joint reunion.

This year's Technology Day is June 8, 1990. We have no fixed plans for a mini-reunion, but I will call classmates who register and suggest dinner together on Friday night after the seminar on "Protecting the Atmosphere and Climatic Changes that Have Occurred."

Denny McNear visited the USSR recently as part of the efforts of the Railroad Administration to work with the Soviets in a developing new relationship. . . . **Bob Crane** writes to describe the impact of Eastman Kodak's acquisition of Sterling Drug on him. He had been director of clinical research, cardiovascular, for Sterling at their Rensselaer, N.Y., facility. He was asked to move to suburban Philadelphia and would have wanted to move again in 1993 when he retired. At the same time, he was offered a severance package if he did not move to Philadelphia. Comparing the incentives associated with each option, Bob elected to retire on October 9, 1989.

Bob and his wife, Jonny, have settled into their home in El Paso, Tex., where they have many friends, the climate is good, and the Mexican food is terrific. Bob expects to teach. With a BS, MS, PhD, MD, and fluency in Spanish, teaching in El Paso at the college level should be available. For the moment, he is a consultant (in cardiology, clinical research, and personal computers). He has a harpsichord, drum set, and Compaq 386/20e in his "office," a separate wing from the house (converted carport). Bob invites classmates to drop in. (Y'all come, y'hear? Mi casa es su casa.)

The class of '48 tailgate picnic at MIT's homecoming game was a success. Virginia and **George Clifford,** Jean and **Milton Slade,** Eleanor and **Harold Ottobrini,** Don Jenkins, his wife, and their friends from the class of '40, (and yours truly) enjoyed a picnic on the grass adjacent to the Westgate living groups. After Virginia's delicious brownies and Jean's freshly cut strawberries, we watched MIT's football team march on down the field to the tune of 56-6 in favor of MIT over Assumption College from Worcester. The weather was balmy, a warm 75 degrees and sunny. I am not a commentator on sports events, but it is safe to say MIT played a very cerebral game, which (combined with their physical prowess and a few 275-pound players) made it tough for the other guys. During the last quarter, MIT fielded their second string teams, and the freshman quarterback led the team to one more touchdown. Assumption's only score was just before the end of the game.

Jim "Pasty" Pastoriza died of cancer in October 1989. In the late 1940s and early 1950s, he helped develop radar tracking systems at the Air Force Research Laboratory in Cambridge. Jim founded and sold electronics companies. The first, uniquely named, Pastoriza Electronics, produced precision A/D and D/A converters. He later merged it with Analog Devices in the early 1970s. Next came Memodyne, which produced high-reliability digital-cassette recording systems for scientific applications. Jim eventually sold that one to Computer Products. In addition, he sponsored and helped make viable several small high-tech companies.

At least two of his developments in electronic circuitry are extensively applied today, no name being attributed to them. With George Philbrick, Jimmy was the first to produce a commercial solid-state operational amplifier. Applying varactor diodes, he and George figured out how to compensate for the unacceptable, characteristically low impedance of transistors. Similar amplifier designs are used in computers and VCRs. And he was the first to create the reference transistor loop for achieving high precision in D/A converters. He sold the patent to IBM.

Jim's inventions revealed his whimsical side, a Mark Twain-like parody of the world around him. Among his most recent, the Pastoriza Penny Packer, automatically wrapped into paper 50-pack rolls "all those damn bothersome pennies we have to deal with these days." With his two-seater, tamdem-driven rail bike, he toured his amazed friends along deserted railroad beds throughout New England.

His computer-operated Rubic Cube Manipulator permitted the user to program in any sequence an indefinite succession of moves on a rubic cube which was manipulated with two opposing mechanical finger pairs. It also would run backward, he pointed out. His Juggling Machine did actually juggle three steel balls two-handedly, aptly serving his purpose to attract visitors to trade show booths in demonstration of sophisticated servo-motor control action.

Jim was a most graceful skier. He had a distinctive Nordic style and glided in wide, sweeping turns, subtly applying modern parallel turning techniques but leaving behind him the rounded zigzag track of the linked telemark. He kept his arms high, his elbows out, gull-like, slowly weaving, flowing equally well through moguls and deep powder.

Ardent hikers and technical climbers, he and Ruth, his wife, spent much time together in the White Montains. He was an accomplished violinist, and he spent many happy hours in later years in quartet with his neighbors and Ruth on the flute.

He was a self-named raconteur. He wrote with elegance, charm, and wit. He could endlessly amuse Jamie, Krissy, and Celia with stories he made up for them when they were children. We adults found his yarns particularly funny.

Fun-loving, widely read, seriously concerned, and perceptive about the conditions of the world, he would call Kemon Taschioglou, '49, from time to time to ask and to discuss, "What did you think about what Reagan said yesterday?" When Jim discovered his cancer in July 1989, he immediately set out a program for obtaining a doctorate in Political Science. He even wrote the outline of his thesis, "Benchmarks for Modern Sovereign States," a computerized database evaluation of the countries of the world. Had he lived to complete it, it would undoubtedly have been very funny, very incisive, and very provocative.

A long time ago, Jim and Kemon shared a bachelor apartment for six years. Jim introduced Kemon to Bach, Haydn, Mozart, and his favorite, Brahms. Kemon ended his obituary with "I shall miss him." I attended a reception Ruth and her children held in their home and expressed our sympathy to them for the loss we all have experienced.—**Marty Billett,** secretary and president, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

A Brass Rat Tale

When Jean Rice of Franklin Lakes, N.J., found a brass rat last summer, she knew right away that its owner would really like to have it back. Notices in the window of the local video shop and liquor store did not uncover a claimant, and her determined inquiries finally led her to the offices of the MIT Club of New York. All Rice could tell Administrative Secretary Sylvia Crone was that someone in the MIT Class of '49 whose first initial was K, M, or W and whose second initial was F, P, or T (a 40-year-old ring is well worn) had lost the ring. After going through the class list, Crone called Kenneth M. Prytherch, '49, also of Franklin Lakes, who was delighted, to say nothing of surprised, to have the ring returned. □

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Being a man of culture and discrimination, I was watching public TV the other day when suddenly the ebullient countenance of **Len Newton** filled the screen. Len was discussing some of the fine points in his field of opinion sampling. One of the themes in the program dealt with the importance of framing questions in such a way as to elicit unbiased answers. One would not, the program pointed out, ask how many drinks the interviewer normally consumed in the course of a day since, in many cases, the answer would be evasive. However, if one did ask and the subject replied that what he drank in a year wouldn't fill a bathtub, the interviewer should be careful not to follow up by asking if the subject didn't really feel he ought to cut back a bit. Opinion polls are in the headlines almost daily, and Len is one of the leading practitioners of the art.

Another prominent classmate whom I recently saw on public display is **Bob Mann.** I was sitting with my wife, Nell, at the Ether Day ceremonies in which the Massachusetts General Hospital confers awards. Nell stepped up to receive her 20-year pin, and soon thereafter Bob came for

ward to receive his also. Bob has received many awards, a tribute to his lifetime of significant contributions to the fields of science and medicine.

Marty Billett, president and secretary of the class of 1948, is promoting a reunion for the classes of '47, '48, and '49 to be held in 1991, approximately midway between the normal five-year reunions of these classes. Many of us have friends in '47 and '48 whom we might never see again were it not for Marty's idea. I will keep you faithfully informed about what I consider to be a wonderful idea.

Class news is always in short supply, and in my November/December column I pleaded that you drop me a line on the grounds that the rest of us would love to know what you are doing or thinking. **Bill Howlett,** bless him, took me seriously and wrote: "A small response to your piteous plea: Enjoyed visit to Boston in September—dinner in honor of Doc Edgerton very well done. Eleanor and I off to Thailand, elephant safari on the Burma border this December. We will ride the elephants up river for a few days, then a bamboo raft down the river. We have nine grand kinder (at last report). I am down to running only one corporation (president, Union Iron Works Co.). Board memberships keep me busy in fits and starts with companies that specialize variously in steel fabrication (naturally), office building operation, process tank design and fabrication, prestressed concrete fabrication, a travel agency, a mobile home park operation, land development, a designer fabrics showroom, and an office trailer rental and sales company. Bill enclosed the gorgeously illustrated annual report of Williams Industries, a major player in the supply of services and products to, among others, the bridge-building industry. Bill is a director of the company.

At our 40th reunion last June, I chatted with **Archie Harris,** a lifelong friend, who uttered not a peep about the fact that he was soon to marry Jeannette Howell. The news reached me in the form of a wedding invitation stating, in raised letters, that the nuptials would be solemnized on November 25, 1989, at the Placentia Presbyterian Church in Placentia, Calif. I am sure I reflect the sentiments of the class in extending best wishes.

I am saddened to report that **William J. Raich,** 62, died on September 19, 1989. He lived in Midland, Mich., as a retiree from the Dow Chemical Co. He leaves his wife of 40 years, Wanda, four sons, two daughters, and eight grandchildren. The class extends its deepest sympathy to the family.—**Fletcher Eaton,** secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

50 40th Reunion

Hank Sharp and **Milt Rand,** along with their wives Harriet and Jane (both Wellesley, '50) explored the Oregon coast last year. They finished at the Shakespeare Festival in Ashland, Ore. They say that if you are looking for clean, uncrowded beaches, they do exist in Oregon. . . . **Hal Weber** lives in San Diego and has a new consulting company, Flow Energy Engineering, which specializes in consulting engineering and design in turbomachinery, fluid flow, and heat transfer. . . . **Suren Semonian** retired last September 30 after 37 years with Uniroyal Chemical. He plans to relocate in Scituate, R.I.

Thomas Buchanan, from Orange, Conn. became president of Acme Fastening System last August. . . . **Richard Henderson** planned to retire at the beginning of 1990. He lives in Colonia, N.J., and is one of many class members planning to attend the 40th reunion in June. . . . **Henry Quigley** who has spent 39 varied years with Dupont, retired at the end of June 1989. . . . **Roger Graham** of Moorestown, N.J., is still working as a patent agent for Rohm and Haas in Bristol, Pa. . . . Congratulations to Dr. **Enders A. Robinson** of Lincoln, Mass., on his election to the National Academy of Engineering in 1988. . . . **Joe Twombly** retired several years ago from MacDonnell Douglas, St. Louis, after 34 years. He lives in Florissant, Mo.

Paul Zorn is enjoying his retirement by both tutoring literarcy for adults and learning to be an artist in charcoal, acrylics, and clay. . . . **Richard Rorshach,** from Kilgore, Tex., is looking forward to visiting with his fellow classmates in Cambridge this June. . . . **Myles Spector** is located in the Los Angeles area and says that he is still enjoying southern California and the international film/video/TV business.

Les Allison is still at Olin in Stamford, Conn., after 37 years, the last 15 in International as director of International Planning. He expects to retire within two years to New Hampshire. . . . **John Hetherington** was promoted to vice-president/corporate director of Architecture at Donahue & Associates, Inc., in Clarendon Hills, Ill. . . . **John Swick** is planning to retire as president of Machy Sales Agency in Caparra Heights, P.R. He plans to do a lot of traveling.

As you can see by these notes, the class has arrived at a time when we have a lot of retirements. If you relocate, please tell your secretary and the Institute your new address. We are trying to locate class members who are not on the register. If you know of any, please contact your secretary.

We regret to have to note the passing of class member **Fred Trombly** of Thornton, Pa. His wife Susan writes that he was very proud to be a member of the MIT family.—**John T. McKenna,** secretary, 182 Midpine Rd., P.O. Box 376, Cummaquid, MA 02637-0376

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Joining about a hundred of his family and friends was a sizable group of '51ers to celebrate **Marvin Grossman's** 60th birthday last October. It was a most enjoyable occasion that Marv took in stride. One highlight was a showing of some home movies of Marv when he was two years old. It showed that he was moving around very quickly even at that age.

We received the sad news that **George A. Brown** passed away in September. He had been a professor of mechanical engineering at the University of Rhode Island for the past 23 years. He published more than 150 papers on internal combustion engines, propulsion systems, and filtration science. He was a member of the editorial board of the American Society of Mechanical Engineers, a member of the Society of Automotive Engineers Technical Committee, a member of the American Filtration Society, and a member of the Office of Naval Research Technical Committee on Internal Combustion. We extend our condolences to his wife Joyce and daughter Pamela.

On another sad note, **David R. Esty** passed away in August. He had been an engineer for Exxon Corp. before retiring. We extend our sympathies to his wife Carmen and others of his family.—**Martin N. Greenfield,** secretary, 25 Darrell Dr., Randolph, MA 02368

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When **Marty Fink** wrote me last summer to mention his retirement, he said he planned to attend the 50th anniversary celebration of the establishment of the Department of Aeronautics and Astronautics at MIT. I asked him to write me about it, since he hoped to meet other classmates. He obligingly did so:

"About 250 alumni and faculty, and many students, attended the lectures and discussions on the 'The Role of the Department of Aeronautics and Astronautics,' 'MIT and Aeronautics,' 'Technology and the Future—Industry Perspective,' and 'Educating Engineers for the Future.'

"The only other member of the class of '52 at this celebration was **Bob Schwanhausser,** who is now president of Teledyne CAE. I met Mo Gionfrido and Mike de Garcia (old friends from the class of '53), and many others among colleagues and faculty.

"Also, I met quite a few people who, like me, have taken incentive offers for early retirement and are now independent consultants or working for job shops. The aerospace industry is shrinking, and companies are trying to reduce costs by eliminating their older, higher-salaried engineers. An unfortunate truth is that few, if any, personnel departments will consider anyone over 50 or 55. I chose to accept an enhanced early retirement offer rather than gamble that I would survive the next few layoffs."

Nick Haritatos called me recently to inquire how I survived the earthquake last October 17. Like most people in the area, we suffered little damage and no injury. (My wife says those cracks in the plaster are new; I maintain they were there before, the result of shifting adobe soil.) It made a mess at work, but that was soon cleaned up; other sites suffered much more. Nick, who lives and works farther from the epicenter than I do, was inconvenienced even less than I was. The quake was exciting, to say the least. The worst part of it all is that it did not reduce the chances for an even worse quake in the future.—**Richard F. Lacey,** secretary, 2340 Cowper St., Palo Alto, CA 94301

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Pickings are rather slim this issue. I received two letters from classmates. **Bob Godfrey** is on his way around the world on a 65-foot ketch. After selling his technical publishing firm, R.S. Means Co, Inc., in 1984, he retired. He spent a few years sailing around the Caribbean, then decided on a more ambitious, around-the-world sailing trip.

He departed Ft. Lauderdale in August 1987 and crossed the Atlantic to the Mediterranean and visited Europe for a couple of months. Then he sailed back across the Atlantic, island hopped through the Caribbean, his old stamping grounds, and transited the Panama Canal. He sailed leisurely to and through the islands of the South Pacific and spent the cyclone season in New Zealand.

Then he traveled through the Coral Sea to Christmas Island, in the Indian Ocean, where his letter came from. His letter came to me in a beautiful first-day cover of the Christmas Island "Wildlife Definitive Part V" series. As a sometimes stamp collector, I'm delighted to receive this collector's item. Bob plans to sail next to South Africa. He says that he expects to be back in the U.S.A. in about one more year. His letter was dated September 20, 1989. His PS indicated he would see me/us at the next reunion. (I just had to get in the commercial.)

My second letter is from **Richard Stoney.** His comments about hard-working class secretaries were appreciated. He retired from Lockheed in February 1987, and he and his wife, Mary Margaret, travel quite a bit, including trips to the East Coast. That is quite a ways from Vista, Calif., where they are currently living. They spent nine weeks last spring driving across the South. They visited Warm Springs, Ga., traveled up the coast to North Carolina, then up to Arkansas, and then home to California.

This year they spent a week in Sedona, Ariz., a week houseboating on Lake Powell, and a week enroute to San Francisco, three days there and then back home. He says he does not miss work at all. In fact, he doesn't have time to even consider working. All I can say is that so many delightful experiences by our retired classmates is reinforcing the idea in my own mind. One of these days. . . .

Richard also spoke of the real challenge he feels in tutoring functionally illiterate adults. He says it keeps him quite busy, and the rewards in terms of observing the progress in these motivated individuals is tremendous. He recommends volunteer work to everyone. He feels that the ef-

fort is sincerely appreciated by the "learners" and is a definite benefit to the community at large.

Richard also said he would be joining us at our 40th reunion. It is not too early for each of you to make a mental commitment, and to set aside the time to join us so you can reestablish some old friendships and make some new ones.

Until next time, so long and remember to drop me a line and let me and the rest of your classmates know how you are, where you are, and what you have been doing. As you see from the foregoing letters, some of you have been doing interesting things and we would like to share in your adventures.—**Gilbert "Gil" Gardner,** secretary, 1200 Trinity Dr., Alexandria, VA 22314, (703) 461-0331 (The recorder at this number in my home has an Arcadia Realty message. Leave your name, phone number, and mention your MIT '53 affiliation. I'll get back to you.)

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A final review of our 35th reunion in June shows that 130 people attended—76 members of the class and their spouses, children, and guests. There were 110 at the Friday night dinner, and 31 made it to Nantucket for the post-reunion party. Let's start planning now for our big 40th in 1994.

Last September, *Inc Magazine* ran a major article on adventure capital. The stars of the article were "The Breakfast Club," a group of four entrepreneurs, operating out of the hills of New Hampshire. Two of the four are our old friends **George Schwenk** and **Dick Morley.** They and their colleagues back new company start-ups with their own time and energy as well as money. They usually serve as co-founders of the new companies with the people who have the idea and "dictate" that the companies succeed. George is the financial expert on the team, and Dick is the technological genius. The group has been very successful in pursuing their "thrilling hobby."

From other sources comes word that **Oscar Sepp** has been given the 1989 IEEE Autotestcon Frank McGinnis Award for Professional Achievement, the highest honor bestowed at the annual automatic testing conference. Oscar was selected for "outstanding leadership, individual initiative, and technical contributions in automatic test engineering." He is president of his own company in Thousand Oaks, Calif., which specializes in aerospace marketing and business development planning. He has been active in the advanced support testing of aerospace systems for more than 30 years.

Don Goldberg, founder and CEO of Goldberg-Zoino & Associates in Newton, Mass., was elected president of the American Consulting Engineers Council of New England last summer. The ACEC/NE represents the business and professional interests of independent, private practice engineering firms throughout New England. Don has also served as president of The Engineering Center and of the Massachusetts Section of the American Society of Civil Engineers.

I am very sorry to have to report the death, last July, of **George Wendell.** George was living in Florida, following his recent retirement from Varian Associates. Our sincere sympathy goes to his family.—**Edwin G. Eigel, Jr.,** secretary, 33 Pepperbush Ln., Fairfield, CT 06430

55 35th Reunion

Class reunion time is a boon to class secretaries because we hear from so many of you. . . . **Frank Buck** informs us that he is operating five (soon to be six) cyclotrons for Du Pont in Billerica, Mass., making radio pharmaceuticals. He still has three of six children at home. . . . **Lloyd Gilson** is currently director of R&D for a Boston-based pharmaceutical company. His wife Marge, 56, still is at Lincoln Laboratory but is running a thriving custom jewelry manufacturing business on the side. They had their first grandchild in October. . . . **Ella Gardner** is now working at the Corporation for Open Systems (COS) in McLean, Vir. The mission of this organization is to promote the adoption of Open Systems interconnection standards for communications.

Ed Gore retired from IBM in June 1989 after 33 years and reports he is going through the process of discovery that there is a real world with real people "outside." Ed started with IBM in marketing and acquired a master's degree from Columbia. His last job was as a group director in information systems. He states that he had managed practically every function at IBM and had an exciting, enjoyable, and rewarding career. Ed has lived in Stamford, Conn., for over 20 years, and he and his new wife have a total of five children. . . . **Donald Steig** was elected a member of the Institute of Management Consultants in New York. He is a principal with Practical Computer Solutions in New Jersey. Don received a master's degree from Columbia in 1956 and is a recipient of MIT's George B. Morgan Award.

Keep the information rolling in so we can continue to bring news of our class.—co-secretaries: **Robert P. Greene,** 100 Memorial Dr., Apartment No. 11-2A, Cambridge, MA 02142; **DuWayne J. Peterson,** 201 E. 79th St., Apt. 11-I, New York, NY 10021

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As part of an informal mini-reunion, **Larry Goldberg** and **Klaus Kubierschy** assembled several mates, spouses, relatives, and friends for an MIT football game in late October, including: **George Brattin, Warren Briggs, Dick Carlson, Chuck Dietrich, George Garfinkle, Gordon Kane, Ted Korelitz, Ron Massa, Bill Northfield, Barry Novins, Phil Trussel,** and **Harris Weinstein.** The play proved to be a very legitimate college game on behalf of MIT: few penalties, no major injuries, and well executed play. Combined with free admission, 50 yard-line seats, 25-cent beers and soda, sociability, Frank Barney stories, and the typical engineer-scientist jargon: such-a-deal. The score: MIT 56, Assumption 6. Our class should make sporting events a regular happening, just as many of us did in the undergraduate days.

We received a bit of golden prose for careful insertion into our notes: **John "Jack" Cotter** runs a successful environmental consulting practice in Laguna Beach, Calif., which is tough duty but someone has to do it. After 15 years of contracting with chemical and manufacturing companies to solve waste management problems, he figures that the current recognition of the environmental business is timely. He and Maggie (his wife) just celebrated their 30th; she is a social worker for local youth programs. Their son John and daughter Ann both live in northern California and are avid travelers and photographers.

Hal McKittrick of Oakton, Va., has a new neighbor from the class of '61: John Sununu. . . . **Robert B. Northrup** has written a book, *Analog Electronic Circuits, Analysis and Applications.* He is a professor of electrical engineering and computer science at University of Connecticut and resides in Chaplin, Conn. . . . If any of you desire a ground hog as a backyard pet for next year, write your Andover secretary—cost to be based on the Samuelson theory—trapping, handling, and shipment not included.—**George H. Brattin,** co-secretary, 39 Bartlet St., Andover, MA 01810, (508) 470-2730; **Irwin C. Gross,** co-secretary, Sweets, McGraw-Hill, 1221 Ave. of the Americas, New York, NY 10020, (212) 512-3181

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Please send news for this column to: **John Christian,** secretary, 23 Fredana Rd., Waban, MA 02168

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Teacher Cum Laude

Maine high school math and science teacher Dan Hester, '67, introduced one of the state's few science programs in which computers are used as scientific tools. His program, along with 14 other computer projects in the state, was highlighted at a demonstration called "Technology in Maine Schools."

Hester returned to teach in his hometown of Hiram, Maine, after leaving a career in aeronautical engineering. He has taught there for 18 years. Five years ago he began using computers in his math, chemistry, and physics laboratory classes. The school bought three Commodore computers and software, and he programmed the machines to communicate with three common laboratory tools: temperature gauges, scales, and light-sensitive timers.

There is something to be gained from hands-on experience with computers. But more important, Hester believes, is that the students have a better grasp of principles when they work with the more accurate data that the computers can provide. Hester also employs modeling equations to demonstrate abstract physics concepts, such as the changing effects of the gravity of the earth and the moon on a bouncing ball. His calculus students learn how to write programs to solve equations.

An all-around teacher, Hester advises the school math club and the hiking club, which has made summer journeys to the Rocky Mountains. □

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Please send news for this column to: **Michael E. Brose,** secretary, 841 Magdeline Dr., Madison, WI 53704

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Please send news for this column to: **Allan S. Bufferd,** secretary, Office of the Treasurer, MIT, 238 Main St., Suite 200, Cambridge, MA 02142

60 30th Reunion

This has been a slow news month for your secretary, although anything would be slow compared with last month's reporting of **Sid Altman**'s winning the Nobel Prize in Chemistry. While I don't expect reports of that magnitude every month, I do need something from you folks in order to write this column. So don't be bashful; drop me a line directly or include a few words with your annual contribution to the Alumni Fund. We really are interested in what you've been doing these last 30 years.

Speaking of 30 years, and as you all know by now, **Jorge Rodriguez** and his committee are well on their way to organizing a super reunion both at Tech and on Cape Cod. I hope many of you will be able to make the June 7-10 festivities.

Sheldon "Every Little Bit Counts" Epstein writes from Wilmette, Ill., to say that his image analysis and communications instrumentation business is prospering, and he, too, cannot believe that we are already approaching the 30th reunion. The speedy passage of time fits well with Epstein's Theory of Relativity—time passes faster as the clock gets older. Shel and Suzy (who continues her career in art history) have a son living in California and a daughter who left San Francisco just before the earthquake and is now in Chicago and a student at the Art Institute. Shel also reminded me that the list of missing classmates on the reverse of Jorge's October reunion announcement may not be missing persons to all of us. Case in point was that Shel and Suzy had just been visiting Richard Levine—whose name was on the missing list—and his wife, Sarah, in Richardson, Tex., where Dick is hardware manager with BNR, Inc. Finally, Shel says that classmate-hams can find him in the evenings on the 20-meter band, call sign K9APE.—**Frank A. Tapparo,** secretary and class agent, 15 S. Montague St., Arlington, VA 22204

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Our fearless leader, **Ben Zarren,** writes that he is spending most of his year in Florida these days. Ah, the pleasures of selling a valuable car dealership. He says that it's better for his aging back, and anyhow he likes hot weather better than what we have up here in Massachusetts. At the beginning of last August, the AEP had their 50th birthday bash in Chicago. Present for the festivities were Phyllis and **Howie Rubin** (from Chicago), Sherry and **Jerry Goldman** (Chicago, too), Joni and **Clement Vaturi** (France), Rachel and **Haim Alcalay** (Israel), Judy and **Mannie Smith** (Va.), Georgianne and **Ken Singer** (Oreg.), Eleanor and **Harry Bluestein** (Calif.), Linda and **Will Kenigsberg** (N.Y.), Brenda and **Ira Jaffe** (Mich.), True and **Rob Fisher** (Pa.) and the **Zarrens.**

Jerry Grossman was featured in an article in the *Boston Buseinss Journal* last October. Jerry, you may recall, runs the New England Medical Center in Boston, a very big business indeed. These days, Jerry is interested in what medical treatments work and what treatments don't. In the article, he was quoted as saying that, even after ten years, running a large medical center was "among the most rewarding, satisfying things to do, being both a physician and someone who has the responsibility to try and bring larger groups of caretakers to help larger groups of patients. I can't imagine anything that I would rather do."

Finally, my call for letters from failures and losers for the April column is beginning to bear fruit. After reading all about the enormous successes of our classmates, it will be refreshing to hear about the winos, convicts, and lawyers in the class. In a class like ours, no matter how well or badly you are doing, there is always someone doing better or worse. Lets hear from you losers!—**Andrew Braun,** secretary, 464 Heath St., Chestnut Hill, MA 02167

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Received a nice letter from longtime class of 1962 secretary, **John Prussing,** who attended the 50th anniversary celebration of the MIT Department of Aeronautics and Astronautics, held at the Institute on September 15-16, 1989. While Course XVI had been granting degrees since 1914, it did not receive independent status as a department until 1939. That made 1989 both a golden celebration for the department and a diamond celebration for the field of study at MIT.

John had the opportunity to visit with classmates **Don Fraser,** Vice-President of the C.S. Draper Lab in Cambridge; **Jim Draper,** president of KTAADN, Inc., in Newton Center; and **John LaGraff,** professor of mechanical and aerospace engineering at Syracuse University. While in Boston, John also had lunch with another classmate, **Bill McFarland,** a staff member at the C.S. Draper Lab.

On the family front, John reports the successful election of his wife, Laurel as Champaign County (Ill.) Auditor. Her official title is The Honorable Laurel Lunt Prussing. John wants us to know that he considers being a professor of aeronautical and astronautical engineering at the University of Illinois at Urbana-Champaign also honorable, but it's not part of his official title. I rather like the ring of the Right Honorable Professor Doctor Mister John Prussing, but I think someone might think John was an Episcopal bishop. And how should we address the Prussings? "The Honorables Ms. Prussing and Professor Prussing!" I generally settle for Director of Medical Archives Mary R. McCarl and her husband Hank, but then things might be more formal when enjoying champagne in Champaign.

John also inquired if I'm on e-mail. Electronic mail is coming to the McCarl household and office since I just (this morning) received a modem with associated cables and connectors. I must now consult with my daughter and son-in-law about modem programs. They run an IBM bulletin board here in Birmingham at (205) 956-1755, called "Crunchy Frog," and have suggested that messages can be transmitted c/o "The Shrubber," my designated handle. If any classmates are fans of Monty Python, they might enjoy contacting yours truly through this e-mail BB. John tells me he has been communicating with Allan Gottlieb of the Puzzle Corner section of the *Review* using e-mail and has enjoyed the experience. My kids tell me that "Crunchy Frog" is a 24-hour, dedicated line, so have at it if you're into e-mail. We would be happy to hear news from classmates that prefer the computer to the post office.

In addition to the letter from John, we received word that **David N. Wormley,** professor and head of Course II at MIT, has been elected a fellow of the American Society of Mechanical Engineers (ASME). Dave was honored for his contributions to curricular development in the area of dynamic systems analysis and design as well as his research on "vortex amplifiers and transportation technology, particularly the development of methods for the modelling, simulation, and design of flexible guideways for elevated transport vehicles, influential in the design of guideway systems throughout the world." Dave has authored and co-authored more than 30 articles in various technical publications and has held various positions of responsibility in the ASME.

We do appreciate news filtering in through the Alumni Office, but I would like you to consider a direct approach via the "Crunchy Frog" at (205) 956-1755 c/o "The Shrubber" by computer BB, or the traditional post office viz.—**Hank McCarl,** secretary, P.O. Box 352, Birmingham, AL 35201-0352

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Please send news for this column to: **Phil Marcus,** secretary, 3410 Orange Grove Ct., Ellicott City, MD

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The news bag is especially thin. As I'm writing, it's the in-between season, just prior to the time when all us loyal alums send in news items with our end-of-year Fund contributions. The one item I do have is a press release from ASM International, the advanced materials society. They announce that **Henry Rack** was installed as a fellow at the Society's annual awards dinner in October.

He was selected in recognition of his "pioneering contributions in high performance materials leading to the development and commercialization of titanium alloy sheet and reinforced metal matrix composites."

Louise and I are now settled into our 150-year-old house in Norwich, Vt. My commute to Dartmouth is down 1.5 miles, which, as winter approaches, is probably about right. If any of you are experts in decorating in the Greek Revival style, please send along tips and hints. Otherwise, please send me your news.—**Joe Kasper,** secretary, RR 2, Box 4, Norwich, VT 05055

65 25th Reunion

I said that last month was almost a "new low" in column size; well, it's been topped. The only bright spot was an envelope from **Dick Gruen,** with return address "Nocturnal Aviation, Palo, Alto." In the envelope was a round pin bearing the inscription "Vote for Richard Gruen, Palo Alto Council." Hope you won, Dick.

In a late-breaking development, class president **Peter Heineman** called and advised me that there *will* be a 25th reunion on campus June 7-10, 1990. More details will follow in the column and in separate mailings. Peter advised me that one event will be the selection of my replacement. Keep in touch in the meantime.—**Steve Lipner,** secretary, 6 Midland Rd., Wellesley, MA 02181

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Paul Liao has been named assistant vice-president at Bellcore in Red Bank, N.J. His group performs applied research on materials and devices for communications networks. Paul has been at Bellcore since 1984 and was at Bell Labs for ten years previously. He and his wife, Karen, have two daughters.

The rest of the class is in the midst of such amazing adventures that they haven't yet had time to write and tell us about it. But they will.—**Jeff Kenton,** secretary, 7 Hill Top Rd., Weston, MA 02193

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Please send news for this column to: **James A. Swanson,** secretary, 878 Hoffman Terrace, Los Altos, CA 94022

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Please send news for this column to: **Gail** and **Mike Marcus,** secretary, 8026 Cypress Grove Lane, Cabin John, MD 20818

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Just when I thought I was out of wind on these notes, I hear from **James Charles Smith,** who recently received the Technical Achievement Award from the American Wind Energy Association (AWEA) at their annual meeting in San Francisco. AWEA gave the award to Charlie for his "valuable contribution to the interfacing and integration of wind energy production into electric utility systems." Charlie has become more involved with the windpower industry since his association in 1988 with Electrotek Concepts, where he was recently made vice-president for Power Systems Engineering. Charlies lives in Knoxville, Tenn., with his wife and three children. . . . Professor **Steven M. Maser** of Willamette University in Salem, Oreg., has been named recipient of the Burlington Northern Foundation faculty achievement award for 1989. Steve is professor of public management and public policy in the university's Atkinson Graduate School of Management. Other than these fine awards, nothing else to report as we in New England experience the first snowflakes of the holiday season.—**Eugene F. Mallove,** secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

70 20th Reunion

Please send news for this column to: **Robert Vegeler,** secretary, Beers, Mallers, Backs, Salin & Larmore, 1100 Ft. Wayne Natl. Bank Bldg., Ft., Wayne, IN 46802

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Richard Tabor Green is the author of *Implementing Japanese AI Techniques—Turning the Tables for a Winning Strategy* published by McGraw-Hill. This book details concrete methods for significantly improving AI Application via cheaper, more thorough Japanese style methods of implementation. . . . Please keep your cards and letters coming in. Your friends want to know what you have been doing, so please write.—**R. Hal Moorman,** secretary, P.O. Box 1808, Brenham, TX 77833

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Please send news for this column to: **Wendy Erb,** secretary, Grosvenor, Apt. 1003, 6001 Pelican Bay Blvd., Naples, FL 33963

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Last month there was exactly one note to report, and this month there is one fewer than last. I'd say we need to get cracking!

No news of great importance here. I'm still with Allen Corp., presently as manager of commercial video teleconferencing sales, dealing in compressed video technology and its applications. This is an exciting field allowing two-way interactive video conferences over digital lines—far less expensive than an analog broadcast and able to be transmitted at a fraction of the line speed. Write!—**Robert M.O. Sutton, Sr.,** secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

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Still dating your checks 1989?

Michael Filosa was recently promoted to research group leader at Polaroid. As of this writing, Michael has two children, Lee Anne and Peter. Peter goes to a special school for learning disabled children in Brookline, Mass. . . . A note from **Alan Fisher** says he and Barbara are moving from Stanford to Brookhaven National Lab on Long Island. "Moving will be much more complicated than before, since we will be accompanied by 3-year-old Stephen and 8-month-old Daniel." Has anyone else out there ever done a cross-country move with children? . . . **Charlabos Psimarnos** is now director of engineering for Premier Cruise Lines, owners and operators of passenger ships, based in Florida.

"I'm very heavily involved in writing about and teaching the C_{11} computer language," writes **William Miller.** "My company's first product, a videotape on the language, will ship in April." That's last April, folks. "I'm also still heavily involved as an elder in my church." . . . Something else that happened last April was **Sheldon Lowenthal's** daughter's first birthday. Hey! Old news is good news! . . . **Donald Higgins** announces the birth of his daughter Mary, who will matriculate at Simmons this June. Donald's been with Harbinger Computer Services for over five years. He's taking up folk dancing in a big way, and really enjoyed himself at Bike Week in Daytona Beach. . . . Debbie and **Dave Vogel** have baby news of their own: Audrey Marie Louise joins her sister Emily Deborah.

Boning up on his studies, **Lawrence Bell** recently became a fellow of the American Academy of Orthopedic Surgeons. As a bonus, Larry was awarded certification of added qualifications in surgery of the hand by the American Board of Orthopedic Surgery. . . . "My consulting firm is now over two years old and is doing quite well on a mixture of utility and insurance regulatory projects," writes **Paul Chernick.** "After a long series of dislocations, I have settled (very permanently I hope) in Lexington with my wife Gila, while we await one more big change: the birth of twins in April." . . . The latest word from **Gary Raymond** says he has been appointed chairman of the American National Standards Institute Committee to standardize the Databus programming language.

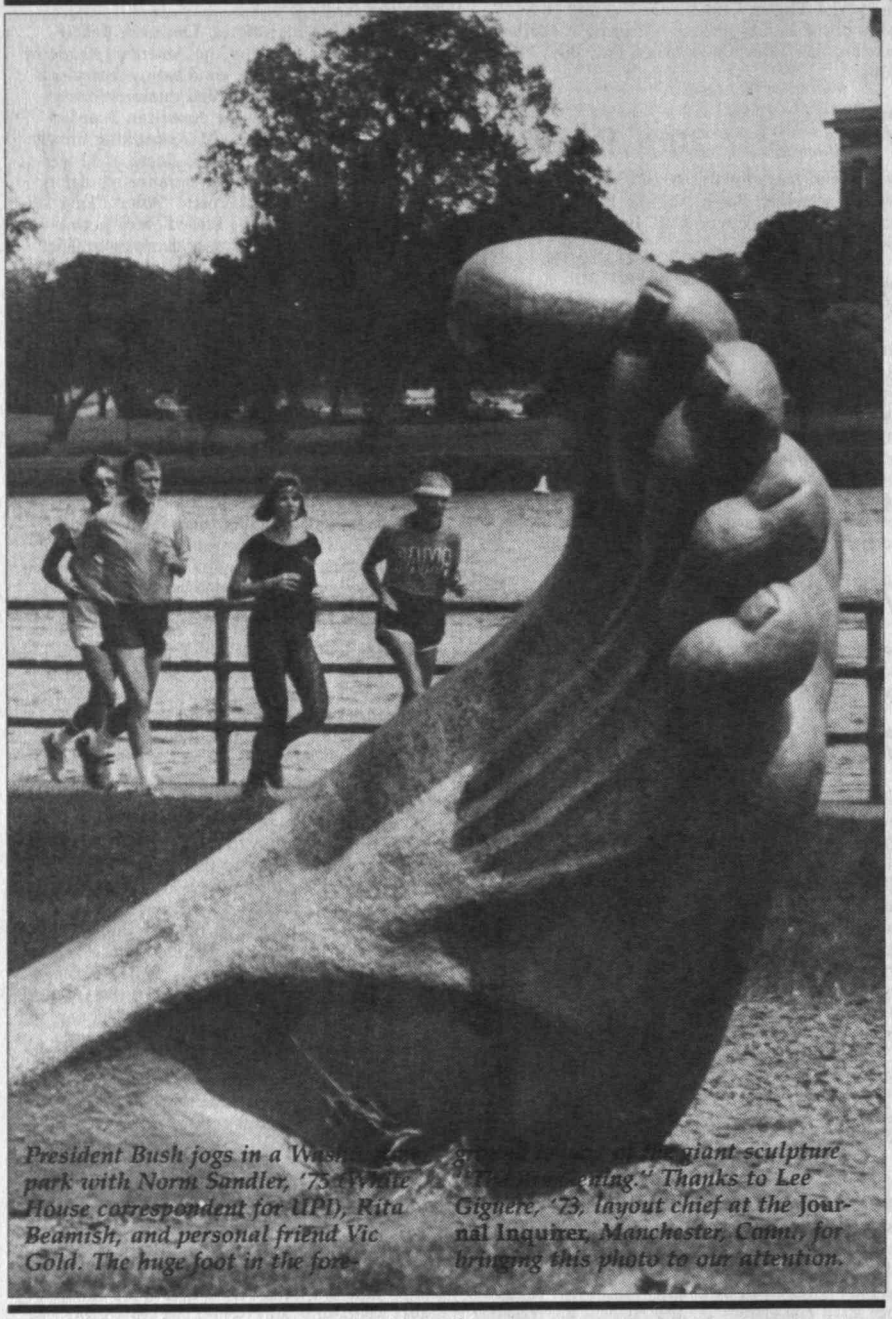
Patty Newbold was promoted to Northeast Division manager for Applied Science Associates over a year ago. Son Alex Gretlein is well on his way to MIT's class of '99 (our 25th reunion year), says Patty. . . . A number of Pittsburgh alumni sponsored MIT's crew team trip to "The Head of the Ohio" regatta. Among them from our class was **Tony Poli.** . . . **Roger Goldstein** writes that he is very busy, still with Goody, Clancy and Associates Architects in Boston, busy with projects (including the new biology building for MIT), keeping busy in his local AIA chapter, and serving as den leader for his son Todd's cub scout pack keeps Roger very busy. Oh, almost forgot! Hi to all Pi Lam's out there!

Paula Bockenstedt and David Fox welcomed their third child, Johnathan, a year ago December. Johnathan joins Sharon and Michelle in the family. . . . **Elizabeth** (Bagnall) **Scarito** has started medical school at the University of Maryland while husband Phil juggles career and full-time fathering of new son Michael. . . . **David Withee** is now more than halfway through his MBA at the University of Dubuque. He's pondering his career, just like the rest of us. Dave is heading up the Direct Sales Division of his firm and says he's trying to gain a Chevy market share on a Yugo budget! . . . **Mick Apted** is now project manager on a multi-year research program for the Japanese Power Reactor and Nuclear Fuel Development Corp. on geologic disposal of high-level waste.

Jim Andrew announces that his company, State Street Ltd., has acquired AET Systems, Inc., of Norwell, Mass. AET manufactures control systems that monitor and regulate environmental systems in commercial, industrial, and special-use buildings. Jim takes over as AET's chairman while still maintaining his position as a principal in State Street, Ltd. . . . **Frank Johnstone** has lives in Kingsport, Tenn., for 11 years. He and his wife Janet have three children: Libby, Mary, and Robert. . . . **Steve Bates** is still working at GenRad in Concord, Mass. Steve has three children, travels frequently, and (when last we spoke) was in Germany. Steve's kids are named Gwendolyn, Jennifer, and Kathryn. . . . Celeste and **Stephen Alpert** both work in University Hospitals of Cleveland in the Department of Pediatrics. Home is Shaker Heights, and daughter Emily is 6.

Robert "Slick Dick" Gahl, a product of Bexley Hall engineering, is presently in solo family practice in Two Rivers, Wis. He and Jan have twin sons, Tom and David, and a daughter, Julie. They are organizing a Bexley Hell (I mean Hall! Sorry.) Reunion to be held Summer '91 for the classes of 1970-1976. If interested, contact Ron Spinella through the Alumni Association.

Sandy Yulke is now the oldest (eldest?) member of MIT's woman's water polo team. She played recently in the Eastern Championships where MIT came in fourth, missing second place by only one goal! . . . **Pete Materna** is consulting and/or job hunting after eight years designing magnetic coils for Tokomaks at the Princeton Plasma Physics Laboratory. . . . **Barry Nelson,** working at Boeing Computer Services in Philadelphia, was promoted to manager of their Artificial Intelligence group. What Barry's really proud of is his four tennis trophies for winning the Boeing



President Bush jogs in a Wash[illegible] park with Norm Sandler, '75 (White House correspondent for UPI), Rita Beamish, and personal friend Vic Gold. The huge foot in the fore[illegible] giant sculpture "T[illegible]ning." Thanks to Lee Giguere, '73, layout chief at the **Journal Inquirer**, *Manchester, Conn., for bringing this photo to our attention.*

Tennis League for the last four years.

James Gokhale and his wife, E. Ann Baker, are the proud parents of a daughter. For Ann, parenting has temporarily taken the place of work at the Digital Equipment Corp. For Jim, he's working two jobs: dad, and president of Gateway Systems. . . . Diane and **Ron Kuppersmith** have two children: Leah and Michael. Ron is director of MIS for Rockport Co. . . . **Louis Gutentag** was married two years ago April to Susan J. Benson, the managing editor of *Graphic Design: USA.* Louis has been vice-president of systems and technology at Prudential Bache Capital Funding on Wall Street for the past three years. . . . **Bruce Karmel** and his wife, Eileen Gibney, had their first child, Lisa Michelle, in May 1989. Bruce is an opthalmologist with his own practice in Manalpan, N.J. . . . **David Hawke** is alive, well, and still Living in San Francisco Bay area with spouse Carla.

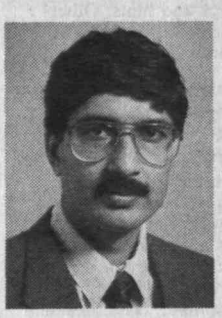
A long article in the *Boston Globe* highlights the work of **Linda Perry** and her organization, the IEEE Consultants' Network. The Consultants' Network helps consultants and those who think they'd like to be a consultant to market their services. Membership in IEEE is a requisite, and you can get more info by calling 1-800-678-4333. . . . As of October, **E. Martin "Marty" Davidoff** has merged his accountant practice with the firm of Wilkin & Guttenplan of East Brunswick, N.J., to become the new firm of Wilkin, Guttenplan and Davidoff, P.C., Certified Public Accountants.

Whew! **Lionel Goulet,** secretary, 115 Albemarle Rd., Waltham, MA 02215-8133, (617) 899-9694 (for the quote of the day)

75 15th Reunion

Ru-Mei Kung writes, "We have purchased and are running a 100-acre almond/walnut farm. We should have our first harvest in the fall (1989). The kids are growing. Yung-Shin, our oldest, will be in high school this fall. . . . From the June 28, 1989, Manchester, N.H. *Union Leader,* I have learned that **Paul Graziano,** a seven-year employee of the Boston Housing Authority, was chosen executive director of the Manchester Housing Authority. With experience in housing, redevelopment, and management, Paul was chosen from an "overwhelming" field of applicants during a six-month process.

Babar Ali Khan has been appointed a Briarcliff Fellow by Philips Laboratories, a division of North American Philips Corp. The appointment is the highest honor bestowed by the Laboratories on any member of its technical staff. Khan, a senior member of the research staff, is the first person to be awarded this distinction. As a fellow, Khan will pursue research work of his choice and will be the recipient of a grant of $20,000 to be used for professional travel during the two years of his appointment (September 1989 through August 1991). Khan joined Philips Laboratories in 1984. He has since been active in materials research focused on the physics of polysilicon thin film transistors and on the recrystallization process in silicon-on-insulators. After several years of notable research, Khan was appointed project leader of an advanced development program which enabled a practical application of research discoveries for which he was responsible.



B.A. Khan, '75

That's all for now.—**Jennifer Gordon,** secretary, 18 Montgomery Pl., Brooklyn, NY 11215

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Please send news for this column to: **Arthur J. Carp,** secretary, Stalco Futures, Inc., 254 West 35th St., New York, NY 10001

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Congratulations are in order for **Deborah Stutman-Brickey,** who was awarded an NSF award in the Visiting Professorships for Women program. She will be teaching and doing research at Ohio State University for a 20-month period that began in July 1989. . . . **Arthur Perez** was recently engaged to Jeanne Posthauer, St. John's '85, and also was recently promoted to senior research scientist in the Pharmaceuticals Division at Ciba-Geigy. . . . **David L. De Bruin** has a growing law practice of 13 attorneys handling complex commercial litigation. He's trying to find ways to apply his science background in his law practice. His third child, Laura, is now a year old. David is already planning a trip to Baja, Calif., for the 1991 solar eclipse.

Jon and **Jo Invester** are living in San Mateo, Calif., with their children Elizabeth, 5, and Benjamin, 3. A new baby was expected in December. Jon is now director of manufacturing for Applied Materials, a capital equipment company for the semi-conductor industry. Jo is now deputy general manager for engineering and administration of the San Francisco Municipal Railway. . . . **Robin Dill** returned last March from a three-year stint in Cairo, Egypt, working as senior geotechnical engineer on construction of the Greater Cairo Wastewater System, a joint venture project between the American and British governments. He returned to Haley & Aldrich, Inc., geotechnical consultants in Cambridge.

I received two informative postcards from classmates just in time to make this column. **Geoffrey Landis,** who started with our class but finished

PHOTO: ASSOCIATED PRESS

in 1980, reports that he recently lost a Hugo award. His story, "Ripples in the Pilac Sea," was nominated for Best Science Fiction Story of 1988. I hope many of you had a chance to read it. He has just returned from Spain where he presented papers at the European Space Power Conference and International Astronautics Federation Congress. Geoff is currently a postdoc at NASA/Lewis in Ohio. . . . **Werner Haag** and his wife, Franzi, recently had twin girls to fill their new house in the San Francisco Bay area. Werner, who has a PhD in chemistry, laments that his current job pays as much (as little?) as that of his younger brother, who only has a BS in computer science. However, he is doing what he enjoys—trying to save the world through environmental research. Werner reports that **Marita Gargiulo Hall** was pregnant at the time of his note, and that **Leslie Leow** is now back in the States after working in Singapore. Leslie married Cheng-Hoon Ow, a physician, last January.

Here in Springfield, I have been as busy as I used to be during the week before finals. I am overextending myself with major commitments to chairing a committee at Joia's Coop School, serving on a committee at Kellen's Coop School, chairing the Northern Virginia MIT Educational Council, running a coupon club, and trying to keep Brielle from climbing the pantry shelves. All of this activity is very stimulating to me, but it takes time away from Paul and the children. **Paul (Hertz)** recently returned from a workshop on Cataclysmic Variable Stars in Santa Fe. Joia just turned 7, and she almost looks cute with her two front teeth missing. Keep those cards and letters coming.—**Ninamarie Maragioglio,** secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153; Computer mail to hertz@ccf3.nrl.navy.mil (internet)

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Sharon and **Frank Murphy,** of Waltham, Mass., are the very proud parents of twin boys, Douglas and Brian, who will be about ten months old when this column is published. The boys keep Frank busy on his days off when he's not being captain in the Cambridge Fire Department. . . . **Al Presser** now has his own consulting practice, providing firmware and other software development services for the Boston area's microprocessor-based equipment manufacturers. Al and wife Dorothy spend their free time renovating their lovely house located in Lynnfield, Mass.

From newspaper clippings: **Gary Zartarian** has joined the staff of Falmouth Hospital in gastroenterology. Gary attended McGill University in Montreal after getting his master's degree from the 'Tute in 1979. He is living in Falmouth with wife Leah Neel and two kids Gregory (2) and Geoffrey (5 months). We wish him well in his new post. . . . Congratulations to **Peter Roemer** who was honored at the GE Research and Development Center for his contributions in the development of self-shielded gradient coils for whole-body and small-bore magnetic resonance imaging systems.

Your secretary and wife, **Diane Curtis,** have temporarily settled in the northern suburbs of Columbus, Ohio, while we search for a farm. Life in the 'burbs of the Midwest is incredibly calm and convenient compared to Cambridge! It's great to be closer to family (three of four collective siblings have ended up in the Columbus environs). Classmates are welcome to visit if in the area!—**Jim Bidigare,** secretary, 2470 Billingsley Rd., Columbus, OH 43235; **Julie Kozaczka Stahlhut,** assistant secretary for Networks, Internet: jstahlhu@hstbme.mit.edu; Compuserve; Julie K. Stahlhut 76566,1012

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Another short one this month. C'mon, everybody, don't make me regret that I was reelected! (Enough of a guilt trip—on with the news). . . . Nancy and **Dave Westenberg** are the proud parents of Matthew James, born last August 14. Dave describes him as "the best, brightest, cutest baby of all times. He's a real joy and growing like the weeds in our untended yard (9.5 pounds at birth, 14 pounds at eight weeks). I'm still practicing law with Hale and Dorr in Boston where I'm a partner specializing in securities law, venture capital, and technology licensing and protection. Recently I've spoken with **Dan Goldberger** who has a new start-up in California, and **Doug Barnard,** who's a lawyer in Chicago and whose wife, Rose, is expecting their first child."

Sailing aficionado **George Celniker** recently gave a Hobie 16 sailboat to MIT, which is reportedly very popular with the students. . . . I noted in a recent issue of *Technology Review* that **Gilbert Moos** passed away last April 13. I have no further information at this time but will certainly pass it on to you as soon as I receive it.—**Sharon Lowenheim,** secretary, 500 E. 63 St., Apt. 18B, New York, NY 10021

80 10th Reunion

Hello from beautiful Bucks County, Pa.! Like all (most?) of you, I am anxiously awaiting spring, not to mention our 10th reunion in June. (You do have the dates marked on your calendar, don't you? If not, do so now: June 7-10.) On to the news.

Tim Winsky writes that he is now living in Michigan and enjoying a new job with BASF Corp. He formulates systems of polyurethane components that are processed into automobile interior components (armrests, headrests, etc.) He is also staying involved with the Naval Reserve. . . **Geoffrey Landis** has completed a PhD at Brown and is now a post-doc at NASA's Lewis Research Center. He is currently working on the problems of manufacturing thin-film solar cells at a lunar base. His "Ripples in the Dirac Sea" was a finalist for the Hugo award for best sci-fi story of 1988.

An update on **Brian Lancaster:** after leaving MIT, Brian taught English for a year in Paris while traveling throughout Europe. He returned to New York City, where he received a master's degree in international finance at Columbia and an MBA at New York University. He then worked for four years at the Federal Reserve Bank of New York as an economist in the International Capital Markets Group, and is now a vice-president in the Capital Markets Group at Chemical Bank (also in New York). . . . **Jim Showalter** recently joined Booz-Allen and Hamilton's Applied Science Center in Arlington, Va. He works primarily on computer-aided (acquisition) logistics support (CALS) contracts. . . . Also in consulting is **Lampros Fatsis.** He works for Ramer and Associates in New York, where he designs and implements "Electronic Labor Forces." Lampros married Cindy Lourie last June.

I received a press release from American Superconductor Corp. in Cambridge; classmate **Yet-Ming Chiang** is a co-founder. . . . **Jim Boots** writes that he still works for Chevron Chemical Co. After spending two and a half years in Singapore as an area representative, he was moved to Houston in 1987 as quality management coordinator. He and his wife Jane have two children, Andrea (4) and Nicholas (1). **James Phelps** also works for Chevron, as a geologist in northern California. He writes that he still travels a bit, mostly to Palm Springs, Kauai, and New England. He and Susan have a 50-pound golden retriever puppy, Maggie, who keeps them busy. . . **Steve Cabaniss** received his PhD in environmental chemistry from the University of North Carolina in 1986 and did post-doctoral work at both Harvard and UNC. He and Julia recently accepted assistant professorships in the Chemistry Department at Kent State.

Thomas Zimmerman reports that he is now living in an artist's loft in San Francisco. He keeps busy doing freelance consulting, studying sitar, and working on "wacky" inventions involving dance-controlled sound synthesis and visual/kinetic sculpture. He expected to be staying at Nu Delta for IAP '90. . . . Also in the San Francisco area is **Linda Jo Dolny,** who was recently promoted to federal marketing manager at Silicon Graphics Computer Systems. She focuses on NASA and DOE national account management. Mountain biking, golfing, backpacking, and skiing keep her occupied when she's not at work.

Scott Kubowicz finished his residency in internal medicine last July and started working as a full-time internist at Kaiser Permanente in Denver, Colo. . . . **Alexander Edsall,** who works for Draper Labs, recently coauthored a book entitled *Concurrent Design of Products & Processes: A Strategy for the Next Generation in Manufacturing.*

Some baby/family news: **Cindy Reedy** and Brad have a son, Charles Bartlett Cummings, born last March 28. His first laughs were at their dog, Molly. Cindy, Brad, and Charles are still living in the Oxford Hills of western Maine. . . . Another Maine-located family, Connie and **David Damery,** also have a new son, Benjamin Rugg, born July 3, 1988, in Portland. David and family live in North Yarmouth, and love life in Maine. David started working as a manager for Data General after receiving his MBA from Carnegie Mellon. . . . **Lisa Masson** and her husband (also a family-practice physician now working full-time in an emergency room) have a daughter, Destie, born May 5, 1989. Lisa expects to finish her residency in family practice in June. She loves the specialty! . . . **Marlon Weiss** also a family-practice physician, now has three children: Noah (2) and twin daughters Molly and Casey, who will be almost a year old by the time you read this column. Marlon, Cindi, and family live in Wichita, Kans., where Marlon is in private practice. They have a station wagon and a shih-tzu dog to go along with the kids!

Family news, continued: Class President **Frank Wojtowicz** and wife Sharon now have two children, Derek Andrew (2) and daughter Brooke Taylor, born last June. . . . **Mary Krull** has a baby daughter, Sydney, born last April. Mary married Thomas Egan in 1984. She's been working at Gillette Research Labs in Boston since 1985. . . . **Pax Goodson** and wife Melissa, '82, also have a young daughter, Ellen, born December 26, 1988. Pax and Melissa recently moved to the Williamsburg, Va., area from Lexington, Mass. . . . Sharon Lowenstein (class of '79 secretary) was kind enough to pass along news of the birth of Stephanie Helene Griffin, daughter of **Tom Griffin** and wife Chris. Stephanie was born in June. Tom finished his PhD in chemical engineering last year and went to work for Shell in Houston.

After all that happy news, I am sorry to say that it is also my job to report the deaths of three classmates. . . . **Jeff McLelland** passed away March 8, 1987. . . . **Steven Yellick** died suddenly on November 30, 1988. . . . Finally, **Jon Mayo** died in his home in Lowville, N.Y. on March 6, 1989. I'm sure I speak for the class in expressing my condolences to the family and friends of these men.

As usual, thanks to everyone who wrote to share their news. Please continue to update us on everything, newsworthy or not. . . . And don't forget the reunion!—**Kate Mulroney,** secretary, 118 Riverview Ave., Washington Crossing, PA 18977

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Please send news for this column to: **Lynn Radlauer Lubell,** secretary, 2380 Northwest 41st St., Boca Raton, FL 33431

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Please send news for this column to: **Stephanie Pollack,** secretary, 135 Sutherland Rd., Brighton, MA 02146

Occupation: Publishing Programmer/Punk-Rock Guitarist

By Max Hailperin, '85

When Jon von Zelowitz, '82, arrived at the Institute in 1978, he had never heard of punk rock; and while he was already interested in computers, he did not yet understand their application to typography. But on the way to a degree in computer science five years later, he set the stage for his present life as a programmer for Adobe Systems, the desktop publishing supplier, and a musician in the punk rock group, the Mr. T. Experience.

During Residence/Orientation Week, he dropped by the offices of *The Tech*, expecting to sign on as a photographer. But *The Tech* already had enough photographers, so someone put him to work in the production shop, saying "Here, hold this X-acto knife." Says von Zelowitz, "I went on to pull the same cruel trick on plenty of freshmen in my time." Before long, he was deeply involved in most aspects of the typesetting shop and was drafted for the position of night editor.

He became absorbed in operating the "homebrew" computerized typesetting system built by Mark Munkacsy, '78 (a physics major who is now an engineer for Raytheon in Rhode Island). Von Zelowitz discovered that the "computer end was not as important as the typesetting end" of the system. It was a discovery, he says, that changed his life. He became more familiar with typesetting, and moved up through the ranks at *The Tech*, becoming managing editor and production manager, with a year in between as arts editor.

Von Zelowitz also stumbled upon punk rock as a freshman. He remembers that he started listening to WMBR as soon as he arrived on campus because "in a fit of freshman simplicity, I figured that since it was the MIT radio station, I should be listening to it." He enjoyed the station's punk rock programs and began going to live shows at local clubs. He went on to become a DJ and eventually WMBR program director.

The musical interest awakened by WMBR was not the only ingredient that led to von Zelowitz's forming his first band. Another, less direct, factor was his self-imposed, two-year struggle with MIT housing, which ultimately brought him to Senior House. It was



there that he began working seriously on the guitar and helped form a group called the Sacred Cows, whose combined experience was zero. So ragtag were "the Cows" that drummer Don Raines, '84, initially banged on upturned trash cans for lack of a drum set. But von Zelowitz, Rains, Ann Walters, '82, Clea Waite, '84, and Craig Hicks, '84, became a fixture at Senior House parties and developed a name on campus. They also played shows at the small punk clubs around Boston and Cambridge and released a cassette of their music.

Somehow, in the midst of all this activity, von Zelowitz managed to complete a degree. He did his thesis in the Visible Language Workshop in the Architecture Department, which helped him understand important visual issues that go beyond computer gadgetry.

After graduating and moving to San Francisco, von Zelowitz expected to work on laser printers but instead wound up designing disk controllers for a year. "It was the old X-acto knife trick all over again," he says. Meanwhile, he DJ'd an evening program on the University of California at Berkeley's KALX-Radio and set up Disorder Records, a not-for-profit, mail-order record distributorship for independently produced punk recordings.

Eventually he and three other musicians put together the Mr. T. Experience, which performed at bars, warehouses, pizza joints, "and anywhere else that would take us."

Von Zelowitz brought to the new band the tongue-in-cheek senseof humor of the Sacred Cows, while his new colleagues gave it a high level of musical professionalism. "It was scary being in a band with people who could play their instruments so well," he says.

In 1986, they released a 14-song LP entitled *Everybody's Entitled to Their Own Opinion*. It was produced on a shoestring during a 15-hour stint in an eight-track recording studio, and the very crudeness of the recording allowed it to capture the group's spirit. The album did reasonably well for the genre—over 2,000 albums sold.

In 1987, the Mr. T. Experience signed on with the Rough Trade Label and recorded *Night Shift at the Thrill Factory*. This LP used a 24-track studio and an outside producer, but what it gained in production quality, it lost in rawness and energy. Von Zelowitz likens *Night Shift*'s problems to the "second system effect" in software engineering, written about by Frederick P. Brooks, Jr.: "An architect's first work is apt to be spare and clean. [The] second is the most dangerous system a man ever designs. The general tendency is to over-design the second system, using all the ideas and frills that were cautiously sidetracked on the first one. The result, as Ovid says, is a 'big pile.' "

An intense appraisal of the flaws of the second album preceded the making of the third record, *Big Black Bugs Bleed Blue Blood*. (Why the title? Says von Zelowitz, "I want to hear radio DJs say it.") The March 1989 release of the record was followed by the band's second national tour. "It wasn't as successful as we had hoped, but we learned a lot and made new fans and contacts."

The Mr. T Experience continues to grow in popularity, playing shows in the San Francisco area as well as out of town. "We are getting paid for a big show on campus at Caltech. I love it—it's the ultimate MIT hack."

Through it all, Adobe Systems has been very accommodating of its new employee's special circumstances, and von Zelowitz is happy to be back on the job now. "But it's nice to know," he remarks, "that I have something to fall back on if the bottom drops out of the desktop publishing business." □

MAX HAILPERIN is a PhD candidate in computer science at Stanford.

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Ellen and **Eric Cigan** sent in a very colorful letter announcing the birth of their third child, Jason Daniel. Jason tips the scales at 8 pounds, 4.5 ounces (thanks Eric, but one significant figure is quite adequate), and joins sister Rebecca and brother Alexander in the Cigan household. Meanwhile, daddy just took a new job as product marketing manager with Mentor Graphics in Beaverton, Ore.

Steve Kosowski contributed the following stream of consciousness reporting regarding the SAE pledge class. We'll leave it up to the individuals mentioned to correct any inaccuracies. Steve is enjoying his work as a consultant as Corporate Decisions in Boston. He reports that **Steve Lubiak** works in manufacturing adhesives, has a kid, and lives in New Jersey. . . . **John English** and Lisa Robertson, '84, also have a baby. John works for Polaroid in the Boston area.

John Keene was working with Sanders in New Hampshire, and is moving to Atlanta. . . . **Steve Pomeroy** finished his PhD in August and is working on ball bearings in Poughkeepsie, N.Y. . . . **Greg Shin** has a baby girl and is working on a PhD in materials science in Texas.

Doug Gouchoe earned his MBA at Harvard and is now working for Mars Consulting and living in New Jersey. . . . **Bob Zalucki** is living in Attleboro, Mass., has two children, and is working for a law firm in Boston.

Morris Keesler, was awarded his PhD in electrical engineering and is now doing postdoctoral research for IBM in Zurich. Morris also has a child. . . . **Todd Huffman** is married and is located on the West Coast with no children recorded to date. . . . **John Schmitz** is living in Cupertino and working for Hewlett Packard. . . . **Steve Liebiger** is working at Fairchild in Seattle and is earning his PhD at night in electrical engineering.

Greg Czuba is living in San Diego and is marketing manager for Remec. . . . **Troy Butell's** whereabouts are unknown. . . . Finally, **Scott Nyberg** has earned his MD at Johns Hopkins and is now married and doing his internship in Minnesota.

I received no news from MIT this month. Presumably that means that no one in the class recently won a Nobel Prize. It's time to start writing down what you're doing and sending it in. Otherwise you'll be destined to read about SAEs every month! Also, remember to write down what you're doing when you give money to MIT, and we'll get it in the column. As for me, I spent the summer involved in the start-up of a medical device company called Angiosonics and am currently serving on the board of directors. Keep those cards and letters coming.—**Jonathan Goldstein,** secretary, 2 Soldiers Field Pk., #201, Boston, MA 02163

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Jonathan Ellman has won an NSF postdoctoral fellowship in chemistry. He completed graduate work at Harvard and will be postdoctoring at UC/Berkeley.

Pamela and **Kevin Soch** have two sons and bought their first house in Paulma Valley near San Diego, with a horse and a swimming pool. Sounds real nice. Kevin is working on his masters in electrical engineering at UC/San Diego. Things are going well for them, and they sound real happy.

Pamela says **Malcom Delaney** was working away on his PhD (in physics?) at University of Illinois. Malcom and **Vinny Natoli** are both in school there, and they see each other for lunch (toast on a stick) about once a week. Pamela also reports that **Laura Lesniewski** survived the earthquake and is at Berkeley working on a Master in Architecture.

Pam Kee sent some computer mail. She moved into the Bay area in May and is working for HP. (On the earthquake front, all the class of '84 I got in touch with or heard about fared pretty well. There was a lot of shake, rattle, and roll according to **Neil Savasta.** But it sounds like everyone is pulling together and will come through it okay. As Dan O, '85, puts it, however, the mental aftershocks may be the toughest part.

Pam likes life down in the Bay and has been running into lots of friends of friends. She also writes (or rats): "Bill Mohr and Carol Webb, '87, moved to Houston. . . . **Ken Haase** has a chair at the Media Lab at MIT. . . . **Karl Ulrich** is also a professor at MIT with an office just around the corridor from mine (HBR). . . . **Nat** and **Liz Brooks** have an active baby, Alexander Louis, born in January 1989. Happy birthday, Alexander!. . . . **Deb Summa** celebrated her first anniversary married to Jim Tencate in October. . . . **Adrienne Lee** and sister Michele, '85, are still in Boulder finishing up their graduate work. . . . **Jean Tom** was recently married to a Rick (of unspecified last name). The wedding was something of a 4W McCormick reunion.

"**Maria Madigan** is at Berkeley finishing her PhD. . . . **Sarah Tabler** is at Harvard in the business school. . . . **Tony "Yarf" Riccobono** is still at Hughes (six years) and is now a manager there. Is CEO far behind? . . . **Jerry Shapiro** married Natalie around Memorial Day. Hopefully, both Jerry and I will be at graduation this June, and I can pour champagne on him again. . . . That is it for Pamela's news. Thanks for all the information.

Vivian Wang is working in New York, has switched jobs, and is quite happy in this new job. She is busy as usual and has not found the time to do some fixing-up in her Upper East Side apartment. Perhaps some New York alums can drop by and help her out.

That is all for now. Think snow. From Boston, **Howard Reubenstein,** secretary, 38 Belknap St., Somerville, MA 02144, (617) 625-9299, hbr@ai.mit.edu.

85 5th Reunion

Pauline Liu and Tom McCormick are finally engaged. . . . **Vince Young** is finishing up his thesis in the MD/PhD program at Stanford. He has noticed an influx of ATOs to the Bay Area. . . . **Chris Schaepe,** Norman Chen, '87, and Rajiv Bahl, '86, have all started at Stanford Business School. . . . Dave Lyons, '86, is in his second year in the master's program in mechanical engineering. He arrived at the same time as Jeff Szylagi, '88, who is working at Amdahl. . . . **Mary Petrofsky** is also in the area. She was busy running a local Red Cross shelter for a week after the quake. Last summer she spent three weeks rafting down the Grand Canyon and is currently teaching first aid and ocean kayaking.

Greg McMullan started a new job at Compass, Inc., in Wakefield, Mass., satisfying a long-held desire to work in the Boston area. He is doing third-party software support for Compass, which basically means that he gets to install and upgrade freely distributable packages like GNU EMACS, X Windows, and TeX that are used by the programmers in writing the compilers (mostly FORTRAN) that the company sells. He is having a great time working for a computer company (really putting his Course XXII degree to good use) instead of the pharmaceutical company he left. He is in the process of finding activities to fill up his free time. One of those is working with Alpha Phi Omega, where he will probably be a representative to a group at Boston University that wants to form a chapter of the fraternity. Last summer Greg spent a couple of weeks in Europe, touring with the senior choir from his church. They sang two concerts and three high Masses in Innsbruck, Vienna, Salzburg, and Brno, Czechoslovakia. They also had seven rehearsals, all in two weeks. It was great fun and quite exhausting.

Sue Felshin and **Stuart Malone** are working at MIT on a project using computers to help teach foreign languages. Stuart and his wife Catherine (Wellesley) just bought a house in Franklin, Mass. . . . **Colleen Humphreys** is married also. . . . **Scott Meeks** and **Caroline Roos** were married last August just before going to Japan where Scott was working for Bellcore with a Japanese company. They are back in the States now. . . . **Barry Klinger** was married last summer, as were **Steve Kukolich** and Linda Webb, '86.

Make your travel arrangements for the reunion if you haven't already! Here are some of the activities: June 7 is Tech Night at the Pops, the 8th is Technology Day (this year's topic is global climatic change), the 9th is the Children's Museum party, and the 10th is the brunch. Remember to send in your contribution to the class gift, specifying the Class of '85 Scholarship Fund.—**Stephanie Winner,** secretary, 1026 Live Oak Dr., Santa Clara, CA 95051; internet:winner@apple.com

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Still not a lot of news this month. Please work on those letters. **Tom McKendree** was nice enough to write in (the only one nice enough!). Anyway, Tom graduated from USC's Department of Industrial and Systems Engineering with an MS in systems engineering. He will start in the fall to work on his PhD in systems architecture at USC. Tom continues to work full-time at McDonnell-Douglas Space Systems Co. in Huntington Beach, Calif., as a systems engineer for HEDI. He recently met **Sarah Dance,** who works for the company on the SDI SE&I subcontract with GE.

Unfortunately, that's all Tom wrote, and with my wedding occuring four days before this article was due, I haven't had time to beat the bushes here in sunny California for news. So send in those letters, and I'll see you when I return from Cancun.—**Mary C. Engebreth,** secretary, 1800 Hermosa Ave., #A, Hermosa Beach, CA 90254

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Happy Holidays!! I hope you all are enjoying the winter season and have a wonderful 1990! I'm sure you have a great deal of information to share with your classmates, so please write. And if writing is a problem, send me some E-MAIL at either dkennedy@oracle.com or gmcathey@athena.mit.edu. **Simson L. Garfinkel** writes "After a tumultuous summer, I have bought my first house and finally settled down in a tiny four-room domicile in Cambridge. This August I finished my novel about my first three years at MIT and I am now looking for a publish er. I'm still computer consulting at Polaroid Research Labs in Cambridge, and I've been writing a lot of articles for *The Christian Science Monitor,* the *Boston Globe* and *MIPS Magazine.* If anyone is in town, look me up sometime!

Alex C. Charney Cohen (previously Alex C. Cohen) wrote in with a special announcement. His son, Zachary Jon Charney Cohen, was born last May 30. Alex hadn't written in yet, so he has lots of information to share: "Two weeks after graduation, I married Sara Charney (my girlfriend of seven years). Two weeks after that, I started working for DEC in Shrewsbury, Mass., in disk drive component manufacturing. We live in Worcester, Mass., and have really come to like the city. I am currently a First Lieutenant in the U.S. Air Force Reserve (I got promoted this summer) and am really enjoying it.

"The same day I started at DEC, **Albert L. Tervalon, III** also started working for the same boss. We share an office (double size), and it is a great people accumulator/hangout. It is not a great place to get work done, however! Al is doing well; he bought a condo in Worcester and is living with his girlfriend, Diana Simplair (Smith '87), who also happens to now work for DEC.

"I also work with Matthew Brown (PhD '88), occasionally with **Ben Godfried,** and see **Alexandra Linde** and Michelle Bonguli, '88, quite often at work. There are an awful lot of other 'DECcies' who are 'Techies,' too numerous to mention and mostly from years long before my years at MIT.

"Hot off the presses! **Simon Lie** and **Edie Erlanson** are engaged! They are both working for Boeing in the Seattle area and having a great time. The wedding will be some time this coming summer. . . . Lt. **Mike Dennis,** U.S.N. has completed navigator's school and is now flying in our defense. He is really enjoying flying, even though he didn't get F-14's. . . . Dan Margolis, '88/co-op, is working for AT&T down in New Jersey. His job seems to consist of Phase II of the writing requirement over and over again (product specifications). He actually seems to like it! I've seen him a couple of times since graduation. . . . I see a lot of Hunter Hancock '86, as he is my best friend (and he lives in Cambridge). He's in the process of getting his second company off the ground, and things look promising for him." . . . Thanks for the help, Alex.

Grace Ueng also wrote in: "Since graduation, I was at Bain & Co. in Boston and then shifted over to work for *Sports Illustrated* at Time, Inc. in New York City. I'm a first-year at Harvard Business School and in the company of many, many MIT alumni including **Kevin Przyhocki,** Sarah Tabler, '84, Mike Cassidy, '85, John Sununu, '86, Nancy Yoke, '85, John Holcomb, '84, Stan Shull, '86, **Ken Kharbanda,** and **Jose Kabana.** HBS is definitely a ton of work, but luckily I'm learning a lot!"

There were quite a few DUs in town to celebrate the marriage of **Greg Mount** to **Allison Cook.** (Greg is now working for Arthur Anderson.) Attending the wedding were **George M. Cathey, Eric "LOBOT" Andrews, Dan Bordli, Tim Jones, Mike "Killer" Roberts, Corey Kerstetter, Tom Zirps, Geoff Kelch,** and **Tom Hoffman.**

And now for the local news. . . . Seen at the Lip-Nose House "Bill and Ted's Excellent Adventure Party" were the following dudes: **Lowell Kim, Dan Kennedy, Janet Zahrahdnik,** George M. Cathey, '88, Anthony Scotti, '86, Rich Roth, '86, Marci Hecker (Brown '89), and myself (all Lip-Nose residents), **Mike Foley, Gene Cohen,** Sue Behson, '88, Alex Jessiman, '88, T.J. Craddick, '88, Don Woodlock, '88, Lisa Shwartz, '89, Sonia Hwang, '89, Jackie Berger, '89, Christine Leveness, '89, Gary Rohrbacher (Lehigh '86), **Sheila Neville, Dave Chen,** Cary Ching, '86, **Bill Von Novak,** and **Maria Kosloski.—Stephanie Levin,** secretary, 41 Prentiss St., Cambridge, MA 02140, (617) 547-6673, (617) LIP-NOSE, dkennedy@oracle.com, or gmcathey@athena.mit.edu.

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Rod Hinman is living in Malden, Mass., with **Tupper Hyde** and Tupper's "sweetheart," Laura Highstone. Rod is getting a PhD at MIT in electrical engineering. He still runs regularly and tries to do at least seven miles a day. He says he draws strange looks from the native Maldenians, probably because he trains in a pair of blaze-orange lycra running pants.

Chad Raymond "is still unemployed after over a year of job searching. Was scraping together a little cash by selling 'Nixon & Quale '92 T-shirts in Kennebunkport over the summer, but the Secret Service put the heat on the local police. All my T-shirts were confiscated, and I was told in no uncertain terms that if I tried any stunts like that in the future, I would be arrested. Am hoping that I will find permanent employment soon because student loans are getting bigger everyday." (Aren't everyone's?)

Chad saw **Joel Simansky** at PkT during Rush (remember that week of food, drinks, sun, fun?) Chad says, "Joel appears to have healed quite nicely after rupturing his liver during a savage soccer game in Fort Worth several months ago. He says that there is no more steel in his body and he doesn't set off airport metal detectors like he used to."

Apparently, **Marty Scheidl** called Chad to update him on the latest. Marty was "downloading programs and waiting for *one* of his girlfriends to meet him at the office. His boat is all fixed and just needs registering beforing launching." Does everyone have it as hard as you, Marty?

David Glassner reports from USC that the lasers there aren't as numerous as they are at MIT. He says that the boys in the lab were able to construct some kind of mini-pizza oven using two IR beams and several mirrors and lenses. Dave took one of the pizzas home and fed it to his fiance because he was tired of cooking her dinner all the time. (Is that true?)

Nirmala Panicker, Kimber Lynn Zinger, Mary Lou Ravese, and **Stephanie Keenan** got together over Columbus Day Weekend. Nirmala got her master's in material science from Cornell this past summer and is now working for IBM in Fishkill, N.Y. Kimber is working for General Scanning and living in Waltham, Mass. Mary Lou is working for Arthur Anderson as a computer consultant and living with her sister in Ossining, N.Y. Stephanie is an ensign in the Navy, stationed at Naval Station New York, in "one of the worst neighborhoods in Brooklyn."

Chris Cook and his wife are staying in base housing at Mather Air Force Base in California. Chris is at navigation training school and will be getting (will have gotten) his naval flight officer wings January 11, 1990. He is then expected to be assigned to P-3 aircraft flying out of Brunswick, Maine.

I talked to **Young Shin** in early November, and he updated me on some Kappa Sigs. Young is currently in a training program at Morgan Stanley. He vacationed in Cancun in December. (He made sure I included this little tid-bit to make everyone jealous). . . . **Bob Bielinski** is working for Shearson and attending Northwestern Kellog Business School at night. . . . **Dante Pogliatti** is in grad school at BU. . . . **Mark Meixner** is in San Diego. . . . **Pat Cobler** will finish his master's in electrical engineering in January. . . . **Andy McAffee** is working in Washington State. . . . **Gary Frantz** is working for a construction/civil engineering co. in Atlanta and living with **Darrell Habberstadt** and Marvin Yu, '86. . . . **Emilio Cacciavillani** is working for Smith Beckam and Beecham Pharmaceutical Co. He wants to go to UC/Irvine. . . . And, once again, **Jim Pierce** makes the headlines by rowing in the winning boat (by 30 seconds!) at the Head of the Charles in October. He rowed for Vesper Boat Club.

Ernie Prabhakar writes from Pasadena, Calif. where he is attending Caltech: "Caltech is very much like MIT, only more so—less women, more nerdly. The students also have a pretty negative (read 'geeky') image in the community, those that even know Caltech exists! After MIT, though, the workload isn't too hard, especially considering that peers have been 'spoiled' by four years of 'normal schools.' After taking 8.321 form Bob Jaffe last year at MIT, breezed through most of the quantum classes."

Ernie finds life similar to that at MIT. He is active in Christian fellowship and a local church. He finds the major absences to be Wellesley and the MIT Assasin Guild. He finds the weather nicer, but misses seasons. Careerwise, he wants to go into high energy physics, and toys with the idea of living overseas after graduation. . . . Ernie ran into **Tom Junk** from Random Hall at SLAC in Stanford and sees **Elizabeth Duxbury** at Caltech. She is back from a year in Japan.

I ran into **Michael Couris** and about five of his Georgetown med buddies at 4 a.m. in (of all places), Atlantic City! He seems to have found an easy way to pay back MIT loans, so he says. He spent the summer with the Navy in Newport, R.I. That's it for this month. Thanks for writing!—**Grace Ma,** secretary, 435 E. 30th St., New York, NY 10016, (212) 689-8780

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I didn't receive many cards this month, but the November-December issue has only been out a few weeks (at this writing), so maybe now that people are starting to see our class column, you'll be writing more, too! Here's what the cards and some other sources report.

John Wang is now working at Lotus and living on Mass. Ave. somewhere between MIT and Harvard. . . . **Jeff DeRosa** is working for Raytheon Missile Systems Prototype Lab in Bedford. . . . **Mike Parker** has been spotted around the Lab for computer Science; apparently he was able to finish his VI-A at Bellcore early.

Tim Sulzbach is finishing his VI-A with Honeywell. He has been living in Davis Square the past year with **Sam Drucker, Mike Berube, Sayan Chakraborty,** and **Andy Shaw.** Sayan is in the MIT Aeronautics and Astronautics Department, and Sam has been doing research for Zortec, a British software company.

Dave Duis is finishing up his VI-A at HP Labs in Palo Alto. When the quake struck, he managed to jump under the desk, where his computer tried to edge him out by shaking all about. Dave has been taking scuba lessons, and will be teaching in one of the scuba classes at MIT in the spring. . . . **Jolly Chen** is also at HP, but he is in Waltham, Mass. He's been working in the Medical Group on patient monitoring software and is also trying to finish his VI-A. Dave and Jolly have managed to help each other with their theses using email.

Amy Lim and **Dave Goldstone** are finishing up VI-As with Xerox in Palo Alto. Dave's office wall has several large cracks put there by the earthquake. . . . **Phil Kuhn** is working at Oracle and had a party recently. Among those present were **Steve Payne, Steve Malinak,** and Nadine Regner. . . . **Brian Lim** is working at the Jet Propulsion Labs on the Hubble Space Telescope project.

Vittal Vasista is in the Mechanical Engineering Department at Stanford working in design. . . . **Mike Fincke** is at Stanford in the Aeronautics/Astronautics Department. After finishing his master's, Mike will join the Air Force as a fighter pilot. . . . **Jeff Applebaum** was recently at Stanford visiting his brother and friends from ATO.

Dean Chang is also out at Stanford. The October issue of the *Review* had a feature article on the robot he is now working on. Dean was working in the Veterans Hospital when the earthquake struck and was able to sprint outside. He reports several seven-foot cracks in the walls of his room.

John Santoro is working for Arthur Andersen and was recently transferred to San Francisco. . .

Sonya Hwang is working in New York for Arthur Andersen, where she is sharing an apartment in the business district with **Lisa Schwartz, Christine LeViness,** and **Jackie Berger. Mike Ho** is also working for Arthur Andersen.

Christie Alvord and I recently received awards from the Tau Beta Pi association for diverse achievements and service, respectively. We were both down at the TBP national convention in Columbia, S.C., where we met engineering students from a lot of schools. We were able to get to the state fair and a football game with Western State College. Also attending the conference were **Arthur Lent** and **Sherrill Briese.**

Gary Curwin is working in the Phoenix area before returning to Cambridge to attend Harvard Law School. . . . **Bill Greenberg** has been teaching a freshman physics class at the University of Washington and was recenlty in Monterey, Calif., giving a talk. . . . **Greg Ritchie** and **Eric Eileraas** are now working at Ford in Dearborn, Mich.

Laura Brauer is at the GE Astrospace Division where she is working on the space station. She is taking an advanced engineering class at the company and has weekly problem sets. She'll be at Rutgers beginning in June.

That's it for now; people want to hear from you so please write! Thanks, **Henry Houh,** secretary, 5380 Hollow Dr., Bloomfield Hills, MI 48013

COURSE NEWS

I CIVIL ENGINEERING

A team of MIT scientists in the Sea Grant College Program has been awarded $217,041 from the Massachusetts Water Resources Authority. The funds are part of a research agreement to study contaminated sediment in Boston Harbor. Scientists at the University of Massachusetts at Boston have also been awarded a similar amount. The MIT researchers are all in the Department of Civil Engineering. Headed by **Keith D. Stolzenbach,** PhD '71, the team includes **Ole S. Madsen,** ScD '70, **Charles C. Ladd,** ScD '61, **Philip M. Gshwend,** and **Eric E. Adams.** The combined MIT and UMass/Boston studies will determine where contaminated particles go and how much material is released from sediments into the water.

Jim Howland, SM '39, reports that for 30 years he was the general manager of CH_2M Hill, consulting engineers, and during that time watched it grow from a four-person firm to one with more than a thousand employees. Corvallis, Ore., where he resides, is home to the firm's first office. One of the 50 offices is in Boston. Now working part-time, Howland finds time to be a trustee of Linfield College and a member of the Oregon Water Resources Commission. . . . **Salvador Miranda-Barreda,** SM '82, is now working for British Columbia Central Credit Union as project coordinator. In addition, he works on some private contracts. He and his wife have two children. . . . **Edward C. West,** SM '56, is president of Agripost, Inc., a public company which converts municipal solid waste into soil conditioner. He writes, "The first plant is almost complete and was partially operational in October of 1989. Full-scale production, 4,800 tons per week, is scheduled for the first quarter of 1990. [When completed,] this Dade County, Fla., plant will be the largest indoor MSW composting plant in the United States."

Claire Welty, PhD '89, is an assistant professor of civil engineering at Drexel University in Philadelphia, Penn., where she is teaching water resources engineering and hydrology. Her research interests are in groundwater hydrology, solute transport modeling, and water resources management.

Konstantine P. Georgakakos, ScD '82, was promoted to associate professor with tenure at the Civil & Environmental Engineering Department of the University of Iowa. He holds an NSF Presidential Young Investigator Award and is a University Faculty Scholar at the University of Iowa. He continues research in hydrometeorology at the Iowa Institute of Hydraulic Research and is one of three technical co-directors of the Computational Laboratory for Hydrometeorology and Water Resources at the University.

Last fall, **Donald T. Goldberg,** '54, was elected the 26th president of the American Consulting Engineers Council of New England (ACEC/NE), which represents the businesses and professional interests of independent, private-practice engineering firms throughout New England. Goldberg is founder and CEO of Goldberg-Zoino & Associates. . . . Tufts University Associate Professor **Lewis Edgers,** PhD '73, has been elected president of the Boston Society of Civil Engineers (BSCES), the oldest engineering society in the country.

Lehigh University President **Peter Likins,** SM '58, was appointed to a six-year term on the board of directors of the Council on Library Resources, headquartered in Washington, D.C. The Council is a private operating foundation that helps libraries take advantage of emerging technologies and improve operating performance. Likins has written numerous articles and engineering mechanics textbooks and has served as a consultant to most major U.S. aerospace companies, as well as government agencies in the United States and Europe. He has served on a number of national and international advisory boards.

Robert A. Karasek, PhD '76, and Tores Theorell are the authors of *Healthy Work: Stress, Productivity, and the Reconstruction of Working Life* (Basic Books). With a tentative publication date in January, the book studies job-related stress and declining productivity, and offers a new approach to creating healthy work environments. Karasek teaches in the Department of Industrial and Systems Engineering at the University of Southern California. . . . Sierra-Misco, Inc., has promoted **David C. Curtis,** PhD '82, from vice-president of marketing and head of the firm's software division in Sacramento, to president and COO. According to a company press release, Curtis' promotion follows five years of increasing revenues, a direct result of his leadership and team-working ability. A pioneer in the computerized flood-warning industry 12 years ago, Sierra-Misco develops, installs, and maintains microcomputer-based systems used in the water telemetry field, including irrigation and groundwater applications.

E. Lionel Pavlo, ScD '32, civil engineer and specialist in the field of suspension-bridge design, died at his home in Manhattan on September 10, 1989. Early in his career, Pavlo worked with master bridge designer Leon Mossief, where his first assignment was to check the stresses in the Golden Gate Bridge towers. Other work with Mossief included stress and deflection analysis of the San Francisco-Oakland Bay Bridge towers. He was the head of his own firm, Pavlo Engineering Co., which he launched in 1947. During this period he was involved in the design of over $1 billion worth of large bridges and highway construction. He was the first to introduce composite design to bridge structures in this country when he used it on the Belt Parkway Viaduct in Brooklyn, N. Y. Pavlo published many articles on the subject which led to the wide acceptance of this practice and the subsequent savings of millions of dollars in construction costs throughout the industry. In 1970, Pavlo was awarded first prize in an international bridge-design competition sponsored by the Italian government.



R. Fuquen



K.M. Zwilsky

II MECHANICAL ENGINEERING

From Arlington Heights, Ill., **Douglas Reitz,** SM '83, writes, "I am currently working for Baxter Healthcare in the Chicago area. I work at the R&D facility on intravenous drug and solution delivery systems. I am active in the local MIT club and enjoy activities." . . .**Ashok Boghani,** ScD '74, manages the transportation consulting practice of Arthur D. Little. . . . **Louis Guy Tarricone,** SM '85, recently married Jean Marie Gudaitis. Self-employed in the Boston area, he works as a consultant in the computer field.

John Psarouthakis, '57, has written *Better Makes Us Best* (Productivity Press, 1989). The book relays his philosophy on performance improvement for any business or individual by focusing on fulfillment in work. A quote on the book jacket says, "Psarouthakis' spirited message is simple, direct, clear, entertaining and refreshingly honest. It would inspire the troops in any and all companies—from the floor sweeper right on up to the CEO—to stand up and cheer for its human warmth and basic truths. Terrific book." Psathouthakis developed his philosophy over the years as the founder of J.P. Industries in Ann Arbor, Mich. His firm seeks out underperforming manufacturers of durable goods, acquires them, and turns them around.

The Alumni/ae Association has learned of two deaths. **George R. Brodie,** SM '32, of Mount Dora, Fla., died August 3, 1989. He spent his career as a mechanical engineer in the printing and graphic arts industry. Over the years he was credited with 13 patents for printing presses and related equipment. He gained a national and international reputation, with clients such as Motter Printing Press Co. and Reader's Digest Co., as well as clients abroad in Germany, Sweden and France. An avid golfer, Brodie built a three-hole golf course on his property, known as the Dane's Run Golf Course. . . . **George Brown,** '51, died September 1, 1989. He was an assistant and associate professor of engineering at MIT from 1954 to 1966, and a mechanical engineering professor at the University of Rhode Island since 1966. At the time of his death, he was a consultant to the Naval Underwater Systems Center in Newport,

R.I., and the Allied Signal Corp. of Morristown, N.J. He was an authority on propulsion systems and combustion of liquid metals.

III MATERIALS SCIENCE AND ENGINEERING

John Zotos, MTE '67, was awarded Northeastern University's Outstanding Alumni Award in Science and Technology for 1989 at NU's Annual Founders' Day Convocation held last October. Currently he is serving NU as professor of mechanical engineering and administrator of the part-time evening program in M.E. He has been teaching on a full-time basis since 1960. In addition, he has done considerable research in materials and metal processing, mathematical modeling, process control, joining processes, etc. He has written many technical papers and books and serves as a material and metallurgical consultant and lecturer throughout the world. Although he is still without any hip joints due to eleven unsuccessful hip implant operations, he has been performing his academic and professional duties without any time losses since the fall of 1986.

Rosendo Fuquen, ScD '82, has been named manager of Nondestructive Evaluation and Sensor Technologies in the Timken Co.'s Technology Center in Canton, Ohio. He started with the company in 1982 as a senior research metallurgist and has also held positions as section leader of steel products research and most recently as manager of material sciences. . . . **Klaus M. Zwilsky,** '54, staff director of the National Materials Advisory Board, Washington, D.C., has become president of ASM International for the 1989-90 term. He moves up to this position after a one-year term as vice-president and trustee of the technical society. . . . **Diran Apelian,** ScD '73, Howmet Professor of Materials Engineering and director of the Materials Research Center at Drexel University, has been awarded the Henry Marion Howe Medal by ASM International. He was selected as one of three authors whose papers were the best of those published in specific volumes of *Metallurgical Transactions.*

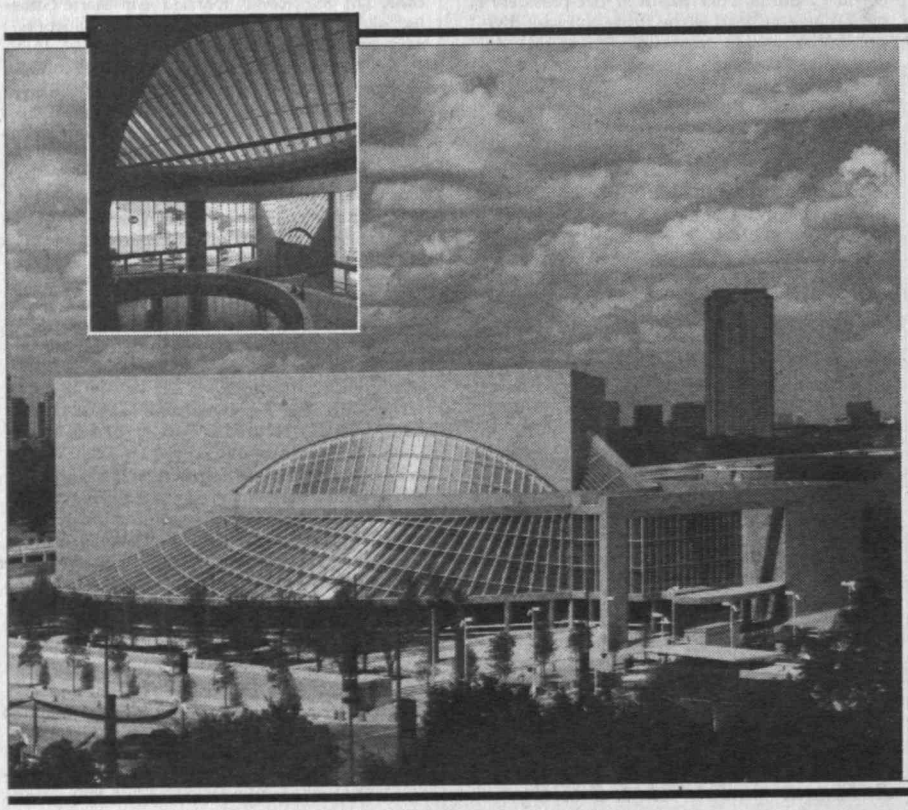
ASM International has recognized as Fellows the following for distinguished contributions to the field of advanced materials: **Matthew J. Donachie, Jr.,** ScD '58, staff project engineer, materials engineering, Pratt & Whitney, "for a continuing commitment to materials education and significant contributions to superalloy development by application of computer techniques"; **David E. Laughlin,** PhD '73, Department of Metallurgical Engineering and Materials Science, Carnegie-Mellon University, "for outstanding research and teaching achievements in continuous-phase transformations as they affect microstructure, properties and their respective phase diagrams"; **Henry J. Rack,** '64, professor of mechanical engineering and metallurgy, Department of Mechanical Engineering, Clemson University, "for pioneering contributions in high-performance materials leading to the development and commercialization of titanium alloy sheet and reinforced metal matrix composites"; **Wayne L. Worrell,** '59, associate dean of Graduate Education & Research, School of Engineering and Applied Science, University of Pennsylvania, "for the development and application of innovative high-temperature materials having novel chemical, electrochemical, and electrical properties"; **Thomas W. Eager,** Leaders for Manufacturing Professor of Materials Engineering, MIT, "for major research contributions to the theory and practice of welding and joining."

IV ARCHITECTURE

An architectural historian and an anthropologist have been selected as the first two winners of the Kevin Lynch Award, which carries an honorarium and is administered by MIT's Department of Urban Studies and Planning. It will be presented annually for a book, research project, or built environment that expands understanding of the human environment or exemplifies the creation of an environment with the participation of the people who use it. The late **Kevin Lynch,** '47, was a distinguished MIT alumnus, urban designer, author, and member of the faculty of the School of Architecture and Planning for 30 years. He helped to develop the Department of Urban Studies and Planning into one of the most renowned in the world. He died in 1984 and family, friends and colleagues organized an effort in 1988 to establish an award in his memory. A portion of the fund supports acquisitions for the Rotch Library of Architecture and Planning. This year's winners were William L. MacDonald, recently retired from Smith College, for his book *The Architecture of the Roman Empire, Vol. II: An Urban Appraisal;* and Eric R. Wolf of the Herbert H. Lehman College of the City University of New York for his book *Europe and the People without History.* In both cases, the committee said, the books embodied the beliefs of Lynch, "who also saw and built connections."

From Portland, Ore., **Aron Faegre,** MAR '76, sends word that his company is designing an educational trail through a tidal area in a state park. He is also working on plans for a low-income housing project, planning a seaplane base, and will soon be performing the musical saw in a short theatrical skit about chaos. . . . **Peter C. Sugar,** MAR '60, writes that his office is in its fourth year and continues to thrive, with four employees and a practice in commercial, residential, and public projects. They won a Commonwealth of Massachusetts DCPO Design Award for their study for the Fort Devens National Guard Armories in 1988. . . . **Robert Deshon,** MAR '40, writes, "Keep the *Tech Review* coming, I look forward to each issue." We like reporting news like that!

Richard H. Kuehl, MAR '67, is now vice-president of the Robinson Green Berretta Corp. He was formerly director of design of the Providence, R.I., architectural, engineering, and design firm. . . . The American Institute of Architects' New England Regional Council has awarded an honorable mention for the design of the addition to Youville Hospital and Rehabilitation Center in Cambridge, to Payette Associates, Architects and Planners of Boston. Principal in charge of the project was **John Ruffing,** MAR '61. . . . **Jeffrey Heller,** '64, is now in his fifth year as president of Heller & Leake, Architects in San Francisco. He recently returned from Soviet Armenia as part of the AIA/CCAIA Armenian Earthquake Urban Design Assistance Task Force. Heller & Leake has just been contracted to design the City Hall Mixed-Use Public/Private Complex in Orlando,



One of the first six winners of the Praemium Imperiale, a new $100,000 international prize for lifetime achievement in the arts, is architect I.M. Pei, '40, the Japan Art Association announced last fall. At left is the new Morton H. Meyerson Symphony Center in Dallas designed by Pei, who was also cited for such works as the Pyramid of the Louvre in Paris and the East Wing of the National Gallery of Art in Washington, D.C. The other winners were conductor and composer Pierre Boulez of France, in music; film director Marcel Carne of France, in theater/film; artists David Hockney of Britain and Willem de Koonig of the United States, in painting; and Umberto Mastroianni of Italy, in sculpture.

PHOTOS: NATHANIEL LIEBERMAN

Fla. They are also working on the tallest high rise to date in Manila, Philippines, and the State Assembly building in Sacramento, Calif. They were winners for the past two years in the San Francisco Office Development Limitation Program, better known as the "beauty contest," for their design of the 524 Howard Street office building in San Francisco.

V CHEMISTRY

Head of the Department of Chemistry **Mark S. Wrighton** is to be the first holder of the Ciba-Geigy Professorship and Research Endowment. The company established a $3 million fund for both a professorial chair and a research endowment in the Department of Chemistry. With international headquarters in Basel, Switzerland, the company is engaged primarily in the development, manufacture and marketing of a wide variety of pharmaceuticals, special-purpose chemicals, electronic equipment, lasers, and vison-care products. MIT President Paul Gray, '54, praised Ciba-Geigy for "its long-term philanthropic commitment to teaching and scientific research." He also noted that this gift "marks the first time an endowment at MIT will support both a professor's salary and the research in the professor's laboratory." Wrighton has published more than 250 research papers and has won numerous awards, including the American Chemical Society's annual award in 1980 as the nation's leading young researcher in pure chemistry and a John D. and Catherine T. MacArthur Foundation Fellowship given to "exceptionally talented" individuals. His work covers a broad range: photochemistry, molecular electronics, surface chemistry, and transition metal catalysis. Among other endeavors, he is trying to convert solar energy directly into electricity or chemical energy by seeking to mimic chemically the process of photosynthesis by which plants convert sunlight, water, and carbon dioxide into energy.

Terry Newirth, PhD '71, is currently taking his turn as chair of the Chemistry Department at Haverford College in Philadephia. During the summer he is also director of a program of science enrichment for mostly minority high-school students. The program is funded by the William Penn Foundation. . . . **Paul D. Mogolesko,** PhD '72, is manager of manufacturing services in the Polymer Products Division at American Cyanamid Co. He has two children and his family resides in Wayne, N.J. . . . From Princeton, N.J., **John E. Sheats,** PhD '66, writes that he was host for Macromolecule-Metal Complexes III at an international conference on metal-containing polymers at Rider College, Lawrenceville, N.J., last summer. . . . **Jeffery S. Carter,** PhD '86, is a research investigator at NutraSweet in the Chemical Product Discovery Group in Mount Prospect, Ill. . . . **Allen H. Keough,** PhD '56, technical director of Metallized Products, Inc., in Winchester, Mass., is now also a director of Vitronics Corp. in Newmarket, N.H.

Lehigh University's **Albert C. Zettlemoyer,** PhD '41, provost and professor of chemistry emeritus, received an award from the American Chemical Society (ACS) for 30 years of continuous service on its national council. He has chaired numerous committees, served on the board of directors, and was national president in 1981. He continues his research in the physical chemistry of inks and printing plates. . . . **Robert A. Laudise,** PhD '56, director of the Materials Chemistry Research Lab at AT&T Bell Labs and adjunct professor of materials science at MIT, has been recognized with an American Chemical Society Award in the Chemistry of Materials. In the October 2, 1989, issue of *C&EN* he is cited as "a leader in research on the chemistry of materials, particularly the growth and properties of single crystals of electronic materials." The article continues, "Laudise's major accomplishment has been the systematic study of the chemistry of hydrothermal syntheses—the use of high-temperature, high-pressure water to carry out chemical reactions and grow crystals that would not be possible at more usual conditions. He and his associates at AT&T Bell Labs helped clarify the processes used to prepare synthetic quartz, which has led to vital commercial applications in frequency control and timing functions in modern electronics. Using hydrothermal synthesis, Laudise has prepared materials ranging from ruby to semiconductors and optical materials such as potassium titanyl phosphate, which is used widely for laser eye surgery. He was among the first to rationalize the chemistry underlying crystal growth and to recognize that chemistry should play a key role in materials and modern electronics." Recently, work done by Laudise in collaboration with colleagues at E.I. du Pont de Nemours & Co. and at Litton Industries, was awarded an R&D-100 Award. They devised a new technique for the preparation of potassium titanyl phosphate which is presently the most efficient material for converting infrared laser light into a highly intense visible green being. An important application is in surgery. These awards are given by *Research Development Magazine* to the 100 most important technological contributions in the United States each year. And to top off this year of solid recognition, the International Organization for Crystal Growth established in 1989 the Laudise Prize, an award for experimental crystal growth. The first Laudise Prize was awarded in Sendai, Japan, last summer.

The Alumni/ae Association received word of the death of **Robert A. Beh,** SM '74, on September 5, 1989. A longtime resident of Somerville, Mass., he was a senior health physics technician at Massachusetts General Hospital. Beh was the author of many scientific publications, as well as a member of the American Chemical Society and the Health Physics Society.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Martin E. Kaliski, PhD '71, a professor in California Polytechnic's electronic and electrical engineering department since 1986, has been named to a three-year term as department chairman. Before working at Cal Poly, he taught electrical and computer engineering at Northeastern University for 13 years. He has been a principal investigator on research contracts with General Electric's corporate R&D program, Northern Telecom, and the Air Force's Office of Scientific Research. The author of numerous technical papers, he has also written two programming textbooks and is now working on a third. . . . **Rulon G. Shelley,** SM '49, has recently retired as president of Raytheon Corp., Lexington, Mass. . . .

Douglas T. Ross, SM '54, has become chair emeritus of SofTech, Inc. He will continue as a director of the Waltham, Mass., company.

Analog Electronic Circuits: Analysis and Applications (Addison Wesley, 1989), a textbook by **Robert B. Northrop,** '56, is already in use at the University of Connecticut, where Northrop is a professor. . . . **Erik Mueller,** '81, has written *Daydreaming in Humans and Machines: A Computer Model of the Stream of Thought* (Ablex Publishing Corp., 1989).

John Delmonte, SM '34, has finished his tenth book. *Metal-Polymer Composites* was sent to press with an anticipated fall 1989 publishing date. Delmonte and his wife recently celebrated their 55th wedding anniversary.

VI-A INTERNSHIP PROGRAM

This is being written in early November, to be read during next February's frigid winter, our unseasonable "Indian Summer" weather will be only a wistful memory. New England's notorious fall foliage season was foreshortened this year, due to week-long rains.

MIT Professor **Richard B. Adler,** ScD '49, who has stepped down as the associate head for Electrical Science & Engineering after eleven years, has now assumed the new position of co-director, along with Professor **Dimitri A. Antoniadis,** of the Microsystems Technology Laboratories (MTL), which he played a major role in establishing. We wish him well in his new position.

A number of VI-A'rs have recently received honors. **D. Bruce Montgomery,** SM '57, has become the first recipient of an annual Fusion Technology Award given by the Nuclear & Plasma Sciences Society of the IEEE. The citation reads "for pioneering contributions to high-field magnet development for both the Alcator tokamaks, for broader fusion applications, and for excellence in engineering management and oversight, both at MIT and at a national level". Bruce is associate director of the MIT Plasma Fusion Center and head of the Center's Technology & Engineering Division. . . . The Japanese government has bestowed the Order of the Rising Sun on Professor **Eugene B. Skolnikoff,** SM '50, for "his many contributions to the promotion of friendship and mutual understanding between Japan and the United States." He is currently in the Department of Political Science and with MIT's Center for International Studies.

Professor **Stuart E. Madnick,** PhD '72, has been named as the first John Norris Maguire Professor of Information Technology at MIT's Sloan School. Madnick, who has made notable contributions in the areas of database systems, operating systems, and software engineering, is also widely recognized as an authority in the management implications of information technology. . . . Named as a new member of the executive committee of the Council on Competitiveness is **Raymond S. Stata,** SM '58, chairman and a founder of Analog Devices, Inc. The Council is a non-partisan group of 158 CEOs representing business, labor, and higher education. "Like father, like son," Ray's son, Raymie '90, is currently enrolled in the VI-A Program.

Michael A. Isnardi, PhD '86, received an honorable mention from the Eta Kappa Nu Association as part of their 1988 Outstanding Young Electrical Engineer awards. Mike is a principal investigator at the David Sarnoff Research Center, Princeton, N.J. . . . A member of the jury for Mike's award was our **Allan C. Schell,** ScD '61, chief scientist, U.S. Air Force Systems Command, Washington, D.C. The jury consisted of six prominent educators, industrialists, or professional leaders. The awards are made annually with an August 1st deadline for nominations for that year.

Last June the Rockwell International Corp. instituted a Graduate Fellowship Program "to encourage engineering and science students to pursue doctoral degrees and become educators." Two MIT VI-As were among the 22 selected this year: **Paul E. Beckmann,** SM '89, and **Theodore M. Bloomstein,** SM '89. Both are currently pursuing doctorates in Course VI following their SB/SMs from VI-A.

Geoffrey J. Bunza, PhD '81, was here on a recruiting visit for Mentor Graphics of Beaverton, Ore., where he is general manager of the Design & Automation Division. Geoff and yours truly had a great reunion over dinner at Legal Seafood.

Edward C. Giaimo, SM '75, phoned following an Alumni/ae Club meeting in Seattle. I learned that Zetron, Inc., where he works, is doing very well—as is his recent marriage. . . . **Carl M. Pietrzak,** '61, of Motorola/Schaumburg stopped by for a visit and had a great reunion with Motorola's VI-A advisor, Professor **Leonard A. Gould,** ScD '53, and VI-A Director **Kevin O'Toole,** NE '57 (XIII).

Jonathan L. Sherred, SM '88, who lives in West Newton, Mass. and works for DEC/Hudson, stopped in one day for a visit.

Lastly, **Thomas R. Shiple,** SM '87, was at MIT for a conference and I had a nice chance to talk with him. Tom is also with DEC/Hudson. . . . We still continue to receive visits and correspondence from VI-A alumni/ae. You're encouraged to follow

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Darlene Vanstone
Brian Michaelis

Of Counsel
Alfred R. Johnson, '35
Joseph Zallen, '39

suit by phoning, writing, or visiting when you pass through the area!—John A. Tucker, Director (Emeritus) VI-A Internship Program, MIT, Rm 38-473, Cambridge, MA 02139.

VII BIOLOGY

Cynthia J. Kenyon, PhD '82, assistant professor of biochemistry at the University of California, San Francisco, has been awarded a David and Lucile Packard Fellowship in Science and Engineering. Kenyon will receive $100,000 per year for five years for research and expenses such as scientific equipment, research supplies, and scholarship support for graduate students.

VIII PHYSICS

Reinhard Schumacher, PhD '83, writes that since 1987 he has been on the faculty of Carnegie Mellon University as assistant professor of physics. Recently reappointed, he is involved in nuclear and particle physics experimental work at Brookhaven, CERN, and the Swiss Institute for Nuclear Physics. . . . **Philip C. Clapp,** PhD '63, professor at the University of Connecticut Metallurgy Department and Institute of Materials Science, was invited to Pakistan as a guest of the government to be a keynote speaker at the International Symposium on Advanced Materials held in Islamabad last fall. Clapp's address was entitled "Advanced High-Temperature Metallic Materials" and reviewed the most currently promising alloy developments for use in applications such as the National Aerospace Plane. He also presented two other papers on experimental and computer simulation studies of fracture in high-temperature alloys.

Lawrence J. Varnerin, '47, professor of computer science and electrical engineering at Lehigh University, has been granted tenure at the rank of full professor. He specializes in magnetic phenomena, devices, and materials. . . . **Donna J. Bastien,** PhD '74, has been promoted to division manager at Bellcore's Navesink Engineering and Research facility in New Jersey. Her group analyzes packet switching and intelligent network products and performs traffic capacity analyses of switching systems. Bastien worked at Bell Labs for ten years before joining Bellcore in 1984. . . . **James S. Hyde,** '54, wears many hats. At the Medical College of Wisconsin he is professor of radiology, chair of the Biophysics Graduate Program, and director of the National Biomedical Electron Spin Resonance Center (a Research Resource sponsored by the National Institutes of Health). Last fall he received an honorary doctorate from Jagiellonian University in Krakow, Poland. Founded in 1364, the University presented the degree in a "rich medieval ceremony" and cited Hyde "for his immeasurable contributions to the discipline of biophysics and to the development of many techniques to probe minute biological systems," according to the Medical College press release.



R.N. Noyce



J.A. Seiden

Lawrence M. Krauss, PhD '82, associate professor of physics and astronomy at Yale University and visiting scientist at the Harvard-Smithsonian Center for Astrophysics, has written *The Fifth Essence: The Search for Dark Matter in the Universe* (Basic Books). From inside the book jacket: "The scientific search for this elusive dark matter is now challenging our keenest minds and most sensitive instruments. At hand are new solutions to such ultimate puzzles as the fundamental structure of matter, the formation of galaxies, and whether the universe will continue to expand forever or halt and reverse, ending in a fiery "Big Crunch." . . . MIT Professor Emeritus **Philip Morrison,** is a contributing author of *The Microverse.* According to the cover, it is "a grand tour of the invisible world that is part of every human being, every atom, and every star. A dramatic collaboration between the world's leading scientists and science fiction authors."

The National Academy of Engineering (NAE) has awarded the first international Charles Stark Draper Prize to **Robert N. Noyce,** PhD '53, and Jack S. Kilby. They are recognized by the scientific and engineering community as "independent co-inventers of the monolithic (meaning formed by a single crystal) integrated circuit, better known as the semiconductor microchip," according to an NAE press release. Noyce is the president and CEO of Sematech in Austin, Tex., as well as co-founder of Fairchild Semiconductor and the Intel Corp. The Draper Prize, to be awarded every two years, honors individuals who have contributed significantly to the advancement of engineering and whose achievements have produced important benefits for the "well-being and freedom of all humanity."

The Alumni/ae Association has received word that Nobel Prize-winning physicist **William Shockley,** PhD '36, died on August 12, 1989, at his home on the Stanford University campus. He shared the 1956 honor for physics with John Bardeen and Walter H. Brattain for their work at Bell Telephone Labs in developing the transistor. This breakthrough made the vacuum tube obsolete and is now used in the brain centers on devices ranging from the space shuttle to videocassette recorders, from calculators to computers. Shockley was also well known for his controversial views on genetics, intelligence, and sterilization.

X CHEMICAL ENGINEERING

Richard D. Packard, SM '51, writes that he is now "completely retired" after a career as a colonel in the Army Corps of Engineers, a consulting engineer with Arthur D. Little, and manager of new product development at Infrared Industries, Inc. . . . **Lisa E. Faeth,** CHE '84, continues to work for the Environmental Protection Agency in Washington, D.C., writing regulations and doing chemical risk assessments. . . . From **Edgar B. Gutoff,** ScD '54, we receive word of his early retirement from Polaroid in the fall of 1988. He is now consulting on coating technology and statistics, as well as teaching one graduate course a year as an adjunct professor at Northeastern University. . . . **Robert W. Davis,** SM '50, has retired as president and CEO from Chevron Chemical Corp. in El Cerrito, Calif.

Ann Reese Comfort, PhD '88, and **James H. Comfort,** PhD '88 have a new son, James Reese Comfort, born on July 5, 1989. They are now living in Yorktown Heights, N.Y., where Jim works for IBM Research. Ann commutes to Ardsley, where she works for Ciba Geigy's Basic Pharmaceutical Research Group. . . . Ferrofluidics Corp. has created a research grants program in honor of **Ronald E. Rosensweig,** ScD '59. He cofounded Ferrofluidics in 1968, served as founding president and technical director until 1972, and then as a member of the board of directors until 1983. He is currently a scientific advisor at Exxon Research & Engineering Co. He was cited for

"outstanding contributions in the fields of ferrofluid science and technology which spans nearly a century." Up to five $5,000 grants will be awarded annually. . . . In Cambridge, **Noubar Afeyan,** PhD '87, has founded PerSeptive Biosystems, Inc., with Purdue University Professor Fred Regnier as his partner. The new company's goal will be "to develop new technologies that assist the biochemist/engineer developing purification processes. Current means of isolating biomolecules and pharmaceuticals are often inefficient and extremely expensive." According to Afeyan, past emphasis has focused primarily on the discovery of new biopharmaceuticals, and his company will focus on the efficient production of these important biomolecules. . . . **Ralph Landau,** ScD '41, vice-president of the National Academy of Engineering, chaired the NAE's 25th Anniversary Recognition Program held last October.

The Alumni/ae Association has been notified of the death of **Howard George Hipkin,** ScD '51, on June 12, 1989. He worked as a chemical engineer in R&D at C.F. Braun for 20 years and at the Bechtel Corp. In 1982 he retired, and was named a Fellow of the American Institute of Chemical Engineers in recognition of his many contributions to the profession.

XI URBAN STUDIES AND PLANNING

An architectural historian and an anthropologist have been selected as the first two winners of the Kevin Lynch Award, which carries an honorarium and is administered by MIT's Department of Urban Studies and Planning. It will be presented annually for a book, research project, or built environment that expands understanding of the human environment or exemplifies the creation of an environment with the participation of the people who use it. The late Kevin Lynch '47 was a distinguished MIT alumnus, urban designer, author, and member of the faculty of the School of Architecture and Planning for 30 years. He helped to develop the Department of Urban Studies and Planning into one of the most renowned in the world.

He died in 1984, family, friends, and colleagues organized an effort in 1988 to establish an award in his memory. A portion of the fund supports acquisitions for the Rotch Library of Architecture and Planning. This year's winners were William L. MacDonald, recently retired from Smith College, for his book *The Architecture of the Roman Empire, Vol. II: An Urban Appraisal;* and Eric R. Wolf of the Herbert H. Lehman College of the City University of New York for his book *Europe and the People without History.* In both cases, the committee said, the books embodied the beliefs of Lynch, "who also saw and built connections."

Gregory Sobel, MCP '88, writes he was admitted to the Massachusetts Bar in 1987 and the New York Bar in 1989. He has a solo law and consulting practice specializing in alternative dispute resolution (mediation) and environmental policy. He is currently serving as associate director for court programs at the Massachusetts Mediation Service. . . . **Jane Adler Seiden,** SM '88, has been appointed project manager at Equity Ventures, Inc., a real-estate development firm in Warwick, R.I.

The Alumni/ae Association has received word of the death of **Alan C. Eng,** MCP '80. He died in a hotel fire while on a business trip to Harbin, China, in 1985.

XII EARTH, ATMOSPHERIC AND AND PLANETARY SCIENCES

Raymond J. Harpin, SM '80, has taken a position with Groundwater Technology, Inc., as a senior geologist. . . . From Marseilles, France, **Andre J. Kermabon,** SM '56, writes that SYMINEX, which



T.E. Fahy

he created in 1974, has focused its main activities in the field of underwater acoustics and associated systems for the defense industry. The company had to face the downturn of the offshore industry, a field they were involved in for over ten years. Last year, his company received the Prize for International Promotion of Technology from the promotion branch of the United Nations. He and his Austrian wife have two children.

A group of student weather forecasters in the department's Center for Meteorology and Physical Oceanography at MIT have captured top honors in all three of the group forecasting categories of the National Forecasting Contest. About 300 students and faculty from 16 universities around the country matched wits in forecasting weather for seven different U.S. cities. The contest, which ran from October 1988 to May 1989, required the participants to forecast every day for a two-week period the next day's maximum and minimum temperatures and amount of precipitation. For the first time in the recent history of the contest, one school has captured three titles: best team average score, best average score for the periods of participation, and best five forecasters.

The Alumni/ae Association has been informed that **Edward B. Temple, II,** '52, died on October 16, 1975. No further information was provided.

XIII OCEAN ENGINEERING

Pabitra Mukerji, SM '80, writes, "I am working as a senior consulting naval architect for McDermott International in New Orleans, where I'm involved in solving problems related to McDermott's worldwide fleet of floating vessels/ships. My work is mainly in hydrodynamics and structural aspects of these vessels. I'm also pursuing a graduate degree in computer science at Duke and Tulane Universities on a part-time basis." . . . **Francis Packer,** NE '51, continues to work part-time as an adjunct math professor at Kean College in New Jersey. He finds it "a good way to ease into retirement." . . . Navy Lieutenant Commander **Richard A. Bass,** SM '89, recently reported for duty with the supervisor of Shipbuilding Conservation and Repair at the Mayport Naval Station, Jacksonville, Fla.

Celebrating the 100th anniversary of its founding, the Webb Institute of Naval Architecture in Glen Cove, N.Y., has designated its first named professorship. **Jacques B. Hadler,** SM '47, is the first James J. Henry Professor of Naval Architecture. Hadler, recognized as an authority on ship hydrodynamics and propeller design, has been on Webb's faculty since 1979. During that time he has also served as the college's dean and as director of research.

Thomas E. Fahy, OCE '76, recently retired from the U.S. Navy, has been named as manager of Washington operations for the SPD Technologies Companies. In this newly created position, Fahy will handle all facets of Washington business with the U.S. Navy and other branches of the military on behalf of SPD.

[Correction: it was reported erroneously in this column last October that MIT Professor of Marine Systems **Ernst G. Frankel,** *MME '60, has retired*

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Keith E. Johnson '80
Deirdre A. O'Neill '85
Chris M. Erikson '85
Gretchen A. Young, '86
Christian de la Huerta, '87

from the Department. Frankel is a full-time faculty member teaching three subjects. Our sincere apologies for the error.]

XIV ECONOMICS

Robert C. Feenstra, PhD '81, has edited *Trade Policies for International Competitiveness,* (University of Chicago Press, 1989). . . . **David A. Garvin,** PhD '79, an authority on the management of product quality and the competitive role of manufacturing, has been promoted to full professor with tenure at Harvard Business School. Garvin's research interests focus on the areas of operations strategy and the techniques of case-method teaching. He is especially interested in understanding the determinants and management of superior quality and service, the role and activities of corporate manufacturing, and the planning and execution of manufacturing strategy. Garvin has published in many journals and has written *Managing Quality: The Strategic and Competitive Edge.* He is collaborating with C. Roland Christensen on a book to be titled *Education for Judgement: The Artistry of Discussion Leadership.* A member of the school's faculty since 1979, Garvin has taught many courses and serves as faculty chair of the executive education course "Manufacturing in Corporate Strategy."

XV MANAGEMENT

Beatrice E. Ballini, SM '86, is a manager at Bain & Co., a management consulting company in Boston. She previously worked for the same company in London and Paris. . . . **Emery G. Olcott,** SM '63, has been named a director of Yankee Systems, Inc., in Rocky Hill, Conn. He continues as president and CEO of Canberra Industries, Inc., in Meriden. **Joel H. Lamstein,** '70, is president of John Snow, Inc. The company celebrated its tenth anniversary and received the largest contract for population services to Africa from the Agency for International Development. . . . **Carl P. Lehner,** SM '80 and **Sandra Lehner,** SM '80 are pleased to announce the birth of a son, Walter William, on Sept 18, 1989. He is their third child.

Michele F. Demarest, SM '79, has been promoted to the position of treasurer of Charles River Associates. As controller since 1982, she had been responsible for all the company's accounting and contract administration. . . . **Allan W. Wiser,** SM '89, has been named an associate in the Cleveland office of Booz, Allen & Hamilton, the international management and technology consulting firm. He will conduct business strategy assignments for the firm's clients. . . . *Manhattan, inc.* magazine has named **Cathy Carron,** SM '84 to the position of advertising manager. She joins the firm after working with MasterCard International where she oversaw European business development as vice-president of the International Division.



A.W. Wiser



D.O. Smart

Sloan Fellows

From Seattle, Wash., **J.H. Goldie,** SM '65, writes "I finished my second book and am trying to peddle it. I've started a third—the hero is a dwa detective!" . . . **Stanley Demain,** SM '60, retired in the summer of 1987. Since then he has been traveling extensively: Egypt, Australia, New Zealand, and even an African safari! . . . **Bernard J. Greenblott,** SM '83 is a new director of Ovonic Imaging Systems, Inc., Troy, Mich. Previously he was at IBM Corp.'s Advanced Manufacturing Systems, Boca Raton, Fla., and he continues as professor of industrial engineering at Florida International University in Miami.

Robert J. Schwinghamer, SM '68, deputy director for Space Transportation Systems, Science & Engineering Directorate at NASA's George C. Marshall Space Flight Center in Alabama, has been recognized as a Fellow by the ASM International for "outstanding contributions to the development of innovative materials and materials processing techniques and application to advanced space systems." . . . Rear Admiral **D.O. Smart,** SM '66, of Overland Park, Kans., ended a 35-year Naval Reserve career last September when he relinquished command of the 17,000-person Reserve Naval Construction Force in a formal military ceremony. He was presented with the Legion of Merit for "exceptionally meritorious conduct in being personally responsible for increasing the mobilization readiness of the Reserve Naval Construction Force." Smart entered the Navy Civil Engineer Corps in 1955 and has risen through the Navy ranks. As a civilian, he is a principal in the newly formed Aqua-Aire Marketing Group, which markets point-of-use water treatment and air filtration equipment.

Senior Executives

Frank P. Silkman, '74, has retired as senior vice-president of manufacturing at Data General Corp., Westboro, Mass. . . . Siecor Corp., Hickory, N.C., has a new chairman and CEO, **Richard Dulude,** '69. Dulude will continue as president of the Telecommunications Group at Corning Glass Works. . . . **Vito H. Baumgartner,** '85, is vice-president of Caterpillar, Inc., in Geneva, Switzerland. He leaves Sao Paulo, Brazil, where he was president of Caterpillar Brazil SA.

Walter Lepori, '71, writes that after he retired from Swiss Aluminum in 1983, he studied history of art and archeology at the University of Zurich, where he received a Master of Arts degree in 1989. . . . **Joseph A. Frankovsky,** '76, is now the staff vice-president of Total Quality Management at General Dynamics Corp.

XVI AERONAUTICS AND ASTRONAUTICS

From Atlanta, Ga., **Satya N. Atluri,** ScD '69, sends word that the degree Doctor of Science (Honoris Causa) was conferred on him last April by the National University of Ireland in Dublin. He was awarded a distinguished visiting professor fellowship by the Japan Society for Promotion of Science in December of 1988 and the "Structures, Structural Dynamics, and Materials Award" of the American Institute of Aeronautics and Astronautics in 1988.

Ken Tebo, SM '47, retired from George Washington University in July of 1988 and is now working on volunteer efforts for the Navy Relief Society, his church, and the U.S. Naval Academy Alumni Association. He continues to live in Falls Church, Va., enjoys summers at his cottage in Wisconsin, and travels extensively. . . . **Stan Rosen,** SM '70, is the director of long range planning, Air Force Systems Command, in the Space Systems Division. In addition, he is director-at-large of the American Institute of Aeronautics and Astronautics.

American astronaut **Byron K. Lichtenberg,** ScD '79, and Soviet cosmonaut Yuri Victorovich

A human-powered vehicle named *Icarus*—after the Greek youth who fell from the sky when his wax wings melted—is designed to start out where its namesake ended up: under water. MIT's entry in the first annual International Human-Powered Submarine Races held last summer in Florida, in another departure from myth, was also able to learn something from its "father," the famous human-powered aircraft.

For more than a year and a half, Clifford A. Goudey, SM '77, a research scientist with MIT's Sea Grant College, had prepared for the race with a group of students in the basement of Building E38. To train their submarine "engines," the students set up an apparatus reminiscent of the Salem witchcraft trials: a submerged recumbent bicycle with a harness to keep the cyclist in place. In another room, Goudey directed the construction of a 16-foot-long, 28-inch-wide, cigar-shaped underwater vehicle.

At the same time, other groups of students and marine professionals from around the country similarly rose to the challenge: to see who could build the fastest, most innovative, and most cost-effective human-powered submarine.

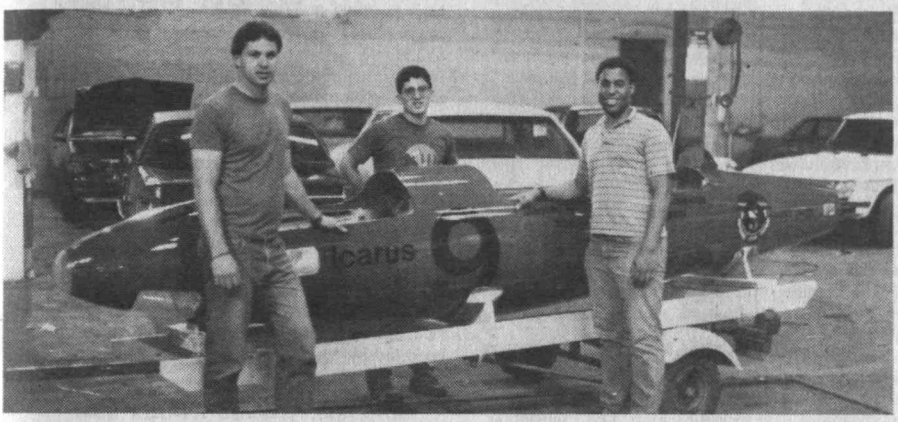
The race was the brainchild of Henry A. Perry, president of the Perry Companies, a Florida-based concern that constructs unmanned underwater vehicles—submersibles—and hyperbaric chambers for medical use. The race was one of many things that Perry's non-profit foundation sponsors to stimulate thinking and research about new possibilities for underwater vehicles.

"The speed at which something goes through the water is a function of two things: the power you are putting into the water, and the drag of the body that you are pushing," explains Perry. "If you limit the power to [a] human being . . . then you have to maximize the design of the propulser and the body shape."

Initially, Perry said, he expected that no more than 5 teams would show up for the competition. In-

BY SIMSON GARFINKEL, '87

Son of *Daedalus* Makes a Splash



Left to right: Grad students Evan Mead (team leader), Al Cangahuala (pilot), and Anthony Joseph (dive master) pose with **Icarus**, *the human-powered sub, in an auto body shop.*

stead, 18 showed up for the three-day event last June.

Most of the submarines look fairly similar: long, thin torpedoes or teardrop shapes, with fins on the sides and a propeller in the back. All of the craft were built with the idea of reducing drag to an absolute minimum while providing the necessary space for a two-person crew—one to pedal, the other to steer. There were some surprises, however, such as a 60-inch-diameter spherical sub built by Innerspace Corp. in Covina, Calif., and an entry by Lockheed Advanced Marine Systems that was powered by a fin instead of a propeller.

The MIT entry, named *Icarus*, was based on a once secret, but now declassified, submarine design developed by the Navy in the 1950s. Goudey's team added a joint to the hull so that the sub could turn the tight corners of the contest course, and equipped the vessel with a magnetic compass, a depth gauge, and an intercom system for the crew.

Icarus' hull was cut in foam blocks that were sent to the Washington County Vocational Institute in Calais, Maine, a trade school that teaches fiberglass boat building. The majority of the construction materials used in the craft were originally manufactured for home auto-body repair. Foam ribs, covered with a polyester resin, gave the hull added stability. The vessel's elevator and fins were designed and cut by the same computer-controlled system that manufactured the control surfaces for *Daedulus*, the human-powered plane that MIT built and flew from Crete to Santorini in 1988.

Icarus' propeller also looks like it was borrowed from an aircraft: instead of the short, fat screws that are common on boats and outboard motors, MIT's craft uses a long, thin, propeller that is more efficient in the low power ranges that a human can produce, says Evan Mead, SM '89, a graduate student working on the project.

Like the other subs in the contest, *Icarus* was filled with water, a contest rule designed to make the subs easier to build and safer to operate, since both of the scuba-certified divers are already carrying their breathing systems. Beginning with a dry weight of 200 pounds, *Icarus* tipped the scales at 2,800 pounds when filled with water and crew. The vessel still floated once at sea.

Indeed, all the contest subs were required to be positively buoyant, so that they would float to the surface of the water in case something went wrong. "That's unfortunate, because that means [the pedaler is] spending some energy to stay underwater," says Anthony Joseph, '88, a graduate student in Course VI who worked on *Icarus* in his spare time.

A week before the contest, the MIT team—including pilot Al Cangahuala, '87, and pedaler Hauke Kite-Powell, '84—went down to the race course in Riviera Beach, Fla., to do the final testing on the sub.

"We got a lot of experience," says Cangahuala. "Working in the warm water made it a lot easier than practicing here in New England." All in all, he says, *Icarus* went out five times.

Originally, the contest's organizers had hoped to spend the first day of the event doing safety checkouts and initial time trials down a 100-meter straightaway. The second and third day were reserved for the subs to compete one-on-one in an elimination tournament, around a one-kilometer course shaped like a canoe. But things didn't go that smoothly once the competition started.

"We were all victims of the weather," says Maggie Linskey Merrill, director of the H.A. Perry Foundation, which sponsored the event with Florida Atlantic University.

Although they were beautiful days for spending at the beach, Merrill says, the blowing wind put a choppy foam on the water and created a strong current on the surface that was moving in a different direction than the current underwater. "Many of the vehicles didn't tow very well, even though they were supposed to," says Merrill.

In the end, only nine of the subs ran their 100-meter time trials successfully. MIT's wasn't one of them: a line that divers were using to hold the sub in place got tangled around the vehicle's oversized prop.

The grand prize for the event went to the U.S. Naval Academy, even though *Subversion*, one of three entries from the California Polytechnic Institute, ran the 100-meter straightaway in 110.69 seconds, or 0.46 seconds faster. The Academy's submarine was judged to be best overall for speed, innovation, and cost-effectiveness combined. MIT won an award from the Naval Coastal Systems Center in Panama City, Fla., for the best-designed student entry. The next Perry-sponsored race will be held in the spring of 1991. □

Simson Garfinkel is a freelance writer in Cambridge, Mass.

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Romanendo gave a presentation entitled "Only One Earth" at Keene State College in October, 1989. They are both members of the Association of Space Explorers, an international professional organization of astronauts and cosmonauts founded in 1985. Their address focused on international cooperation and use of space technology for the benefit of all people and nations.

XVII POLITICAL SCIENCE

MIT's Center for International Studies is sponsoring the fifth Emile Bustani Middle East Seminar series. The seminars and speakers are: "The Search for Middle Eastern Peace: Prospects and Perspectives" by Ambassador Richard Murphy; "Islamic Movements in the Middle East: Successes, Failures and Prospects" by Malise Ruthven, BBC of London; "The Iranian Revolution and Its Implications Ten Years After" by Professsor Nikki Keddie of the University of California at Los Angeles; and "The Gaza Strip: Critical Effects of the Israeli Occupation and the Palestinian Uprising" by Sarah Roy, visiting fellow at the Center for International Studies. The seminar is funded by the Bustani family of Beirut, Lebanon, in memory of the late **Emile M. Bustani,** who received an SB in civil engineering from MIT in 1933.

Ramon C. Barquin, PhD '74, writes that after four years of living in Hong Kong, he returned to the U.S. to manage the corporate public affairs programs of IBM in Washington, D.C., where he has been for the last five years. Public affairs work notwithstanding, he has managed to coedit three books over the last few years: *Towards the Information Society* (1984), *New Ethics for the Computer Age?* (1988), and *Computers and Ethics: A Sourcebook for Discussions* (1989). He is continuing to play squash and is still the statistician for the International Judo Federation which took him to Seoul last year. . . . **Alma Harrington Young,** PhD '78, professor of urban and regional studies at the University of New Orleans, was elected chair of the Board of Commissioners of the Port of New Orleans. She is the first woman to serve on the board since its inception in 1896 and is she also the first black woman in the United States to head a public port authority.

. . . Holy Cross College has appointed **Peter G. Bruce,** PhD '88, assistant professor of political science.

XVIII MATHEMATICS

The University of Lowell Board of Trustees has granted tenure to **David Finch,** PhD '77, associate professor of mathematics in the College of Pure and Applied Science. . . . Bowdoin College announced that **Robert Wells Johnson,** PhD '64, has been named Isaac Henry Wing Professor of Mathematics. Upon graduation Johnson joined the Bowdoin faculty and in 1975 was promoted to full professor. He has served as chair of the Department of Mathematics three times and has published numerous articles. His research interests include algebraic number theory and Diophantine equations, cyclotomic fields, Fermat's Last Theorem, irregular primes, and Bernoulli numbers, among others.

The Alumni/ae Association has received word that **Martha H. Williams,** PhD '39, died on July 22, 1989. She had been residing in Wilmington, Del.

XX APPLIED BIOLOGICAL SCIENCES

Vernon R. Young, professor of nutritional biochemistry, is one of eight alumni honored by the University of California, Davis, for professional accomplishment and community service. Young received a doctorate in nutrition from UCD in 1965. . . . **James E. Tillotson,** PhD '64, joined the Tufts faculty at the School of Nutrition last spring as professor of food policy and director of the Food Policy Institute. This position follows his retirement as vice-president of R&D at Ocean Spray Cranberries, Inc.

XXI HUMANITIES

Harriet N. Ritvo, associate professor of writing in MIT's Writing Program, is among 198 artists, scholars, and scientists named Guggenheim Fellows for 1989. The new Fellows, selected from among 3,144 applicants for awards totaling $5,251,000, were appointed on the basis of "unusually distinguished achievement in the past and exceptional promise for future accomplishment." . . . The American Institute for Physics has given its Science Writing Award in physics and astronomy to **Mark Littmann,** '61, for his book, *Planets Beyond: Discovering the Outer Solar System.* Littmann is president of Starmaster Corp., an educational publications company.

New in the Artificial Intelligence Series is *Implementing Japanese AI Techniques: Turning the Tables for a Winning Strategy* by **Richard Tabor Greene,** '71. . . . *Alternative Conceptions of Phrase Structure* (University of Chicago Press, 1989) is a new book coedited by **Mark R. Baltin,** PhD '78, and **Anthony Kroch,** PhD '74.

XXII NUCLEAR ENGINEERING

Jerome H. Goldberg, SM '60, is executive vice-president of Florida Power & Light Co. He was previously group vice-president of Houston Lighting & Power Co. . . . As an executive consultant with Tenera, **William R. Corcoran,** PhD '71, is serving on the corporate nuclear safety review boards for five nuclear stations. He is also doing readiness review work and procedure system audits at other nuclear facilities.

TPP TECHNOLOGY AND POLICY PROGRAM

Steve C. Anderson, SM '87, has been working in the suburbs of Frankfurt for the GTZ, the West German version of the U.S. Agency for International Development. He is now in the Energy Division, responsible for energy planning activities principally in the SADCC nations of Africa and in South America. . . . **Moctar Fall,** SM '84, is a vice-president at Salomon Brothers, Inc., in New York. . . . **Elias N. El-Hani,** SM '75, is still active in the construction field. He has been appointed project manager of the headquarters of the Arab Fund (equivalent to the World Bank). . . . **Simon Stokes,** SM '88, is attending law college in London. . . . **Dave Summa,** SM '85, left his position at Procter & Gamble, and is now with McKinsey and Co. in Chicago.



P.G. Bruce



A.H. Young

G. Peter Grant, 1912-1989

G Peter Grant, '35, who was director for clubs of the Alumni Association from 1966 until his retirement in 1977, died in Sarasota, Fla., on October 2; he was 77.

Grant joined the Alumni Association staff after a career in photographic retailing in the Midwest, where he was active in several MIT alumni clubs. At the Institute for 11 years beginning in 1966 he was responsible for Alumni Association activities supporting alumni clubs throughout the United States and overseas; he traveled extensively and was well known among club officers. Grant also assisted in preparations for a number of major regional MIT conferences, and he was instrumental in club fund-raising activities. □

Walter Wrigley, 1913-1989

Walter Wrigley, '34, who as a member of the faculty shared with the late Charles S. Draper, '26, much of the pioneering work on gyroscope-based inertial guidance systems, died of cancer on November 5 at his home in Quincy. He was 76.

In MIT's official announcement of the development of inertial guidance in 1957, Wrigley—then professor of aeronautics & astronautics and educational director of the MIT Instrumentation Laboratory—was credited with basic work on the gyroscopes that made the system possible; he had been a project engineer at Sperry Gyroscope Co. for six years after receiving his doctorate in physics from the Institute in 1941.

Wrigley was co-author (with Draper) of the first paper on inertial guidance in the unclassified technical literature, and he later wrote the first textbook in the field, *Gyroscope Theory, Design and Instrumentation.*

Wrigley's association with the Instrumentation Laboratory began in 1946, when he became assistant director. He joined the MIT faculty as associate professor in 1951 and was named associate director of the laboratory; he was promoted to professor in 1956. From then until retirement in 1975 as education director of the laboratory and its successor, the Charles S. Draper Laboratory, Inc., Wrigley was advisor to MIT graduate students who did classwork and thesis research in the field of guidance. Among the latter were four men who went on to become astronauts, including Buzz Aldrin, ScD '63, a member of the first Apollo lunar-landing team.

Wrigley was born in Brockton; after graduating from MIT with a bachelor's degree in physics, he worked for three years as a physicist at Interchemical Corp. before embarking on graduate work in physics and aeronautics & astronautics. He was a long-time member of the Air Force Academy Advisory Council and of the Air Force Scientific Advisory Board.—*John Mattill* □

H.W. McCurdy, 1899-1989

Corporation Life Member Emeritus H.W. McCurdy, '22, died in Seattle, Wash., on November 13; he was 90 years old.

A native of Port Townsend, Wash., "Mac" McCurdy entered MIT to study mechanical engineering after serving in the Navy during World War I. When he arrived in Cambridge intending to continue the rowing he had done at the University of Washington before the war, he discovered that MIT had neither a boathouse nor rowing shells. So McCurdy put together a rowing team, which in his senior year achieved varsity status and elected him captain.

In the ensuing years, McCurdy funded a series of shells, the McCurdy Lounge in the Pierce Boathouse, the H.W. McCurdy Endowment for Crew, and in 1988, the nation's first coaching chair for crew. His tireless efforts earned him the official sobriquet "Father of MIT Crew." He was also a member of the National Rowing Hall of Fame.

Upon graduating from MIT, where he was elected a charter member of Tau Beta Pi (the first honorary society at the Institute based on scholarship), McCurdy began work as a laborer and timekeeper for the Puget Sound Bridge and Dredging Co. He rose through the ranks to become chairman of the board in 1959, retiring in 1963 when the company was sold to the Lockheed Aircraft Corp. He continued in business as chairman of the Puget Sound Dredging Co., a family-owned concern, until his death.

In addition to his membership in the MIT Corporation and his long-standing largesse to MIT crew, McCurdy contributed to the Institute in numerous other ways. He served as a member of the Education Council in Seattle since 1934, twice as vice-president of the Class of '22, on the Alumni Council, as chairman of the Second Century Fund, and as an honorary chairman of the Seattle *Campaign for the future* committee. He was awarded a Bronze Beaver in 1983. □

George A. Brown, 1929-1989

George A. Brown, '51, of Kingston, R.I., died of a heart attack on September 1 in Sanford, Maine; he was 60. From 1954 to 1966, Brown was an assistant and associate professor of engineering at MIT. Since 1966 he had been a professor of mechanical engineering at the University of Rhode Island in Kingston.

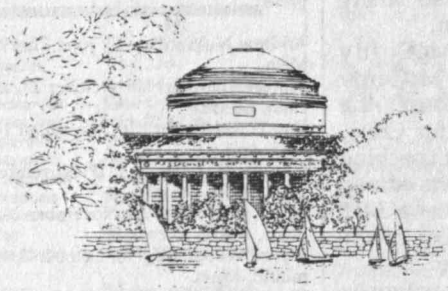
At the time of his death, Brown was a consultant to the Naval Underwater Systems Center in Newport, R.I., and the Allied Signal Corp. of Morristown, N.J. The recipient of an SM in 1952 and a PhD in 1960, both in mechanical engineering from MIT, Brown was an authority on propulsion systems and combustion of liquid metals. □

Deceased

The following deaths have been reported to the Alumni Association since the *Review* last went to press:

Andrew N. Wardle, '15; June 21, 1989; Union, Mich.
Miguel Marquez, '16; October 23, 1989; Chihuahu Chih, Mexico.
Roy L. Sidelinger, '16; November 14, 1989; Sun City, Ariz.
Harrison P. Eddy, Jr., '17; November 7, 1989; Manchester, Mass.
Alvah E. Moody, '17; November 28, 1988; Longmont, Col.
Myron W. Adams, '18; October 2, 1989; West Falmouth, Mass.
Thomas M. Knowland, '18; October 27, 1989; Charlotte, N.C.
Leonard I. Levine, '18; August 22, 1989; Brookline, Mass.
John M. Erving, '19; April 20, 1989; Hartford, Conn.
Mildred L. Coombs, '20; October 27, 1989; Bremerton, Wash.
Lyman P. Whitten, '20; September 29, 1989; Perrine, Fla.
Harrol W. Baker, '21; August 19, 1989; Lakewood, Ohio.
Franklin Carroll, '21; September 13, 1988; Littleton, Col.
Edward M. Richardson, '21; September 11, 1989; Cambridge, Md.
Howard Davenport, '22; January 16, 1989; Ghent, N.Y.
George G. Marvin, '22; April 10, 1988; Fort Myers, Fla.
Horace W. McCurdy, '22; November 13, 1989; Seattle, Wash.

Mac D. Perkins, '22; October 7, 1989.
Mrs. Everett M. Strong, '22; April 30, 1989; El Toro, Calif.
Dwight VandeVate, '22; September 25, 1989; Rochester, N.Y.
Russell W. Conant, '23; October 18, 1987; Solvang, Calif.
Arthur W. Germer, '23; June 11, 1989; Burnt Hills, N.Y.
Charles B. Ford, '24; October 2, 1989; Middle Village, N.Y.
Alfred Gargaro, '24; November 14, 1989; Framingham, Mass.
Clarence W. Moore, '24; September 13, 1989; Columbus, Ga.
Arthur Fenstermaker, '25; March 15, 1989.
Oscar Ramis, '25; June 9, 1987; Montevideo, Uruguay.
John A. Gibson, Jr., '26; July 30, 1989; Morgantown, W.Va.
Alfred D. Petterson, '26; October 26, 1989; Bridgeport, Conn.
William H. Taylor, '26; July 18, 1989; Waverly, Ohio.
Nathan Cohn, '27; November 16, 1989; Scottsdale, Ariz.
John P. Engel, '27; March 1988; Stratford, Conn.
Grenville B. Gerrish, '27; September 25, 1989; Melvin Village, N.H.
Paul J. Harrington, '27; June 18, 1989; Westfield, N.J.
Yuk Wing Lee, '27; November 8, 1989; Belmont, Calif.
Charles J. Pedersen, '27; October 26, 1989; Salem, N.J.
Walter B. Dean, '28; May 30, 1989; Easton, Md.
James E. Tully, '28; October 15, 1989; Cumberland, Maine.
Edward E. Reigle, '29; September 21, 1989; Midland, Tex.
Willard H. Cobb, '30; October 18, 1989; Scotia, N.Y.
Earl E. Ferguson, '30; October 13, 1989; Glen Ridge, N.J.
Charles B. Gale, '30; September 18, 1989; La Grange, Ill.
Amerst E. Huson, '30; December 25, 1987; McLean, Va.
J(acob) Clarence Peters, '30; January 12, 1989; Rydal, Penn.
John M. Weaver, '30; October 9, 1989; Spokane, Wash.
Robert H. Baxter, '31; December 6, 1988; Jacksonville, Fla.
Frederick V. Branch, '31; July 1988; San Antonio, Tex.
Henri Goetz, '31; August 12, 1989.
Raymond Jacques, '31; October 26, 1989; Attleboro, Mass.
Ronald F. Jameson, '31; March 1988; Newport, Maine.
David B. Lawrence, '31; May 11, 1988; New Orelans, La.
M(orris) Righton Swicegood, '31; April 1988; Maitland, Fla.
Frances M. Waltz, '31; December 10, 1988; Phoenix, Ariz.
Robert D. Butler, '32; February 3, 1989; Sarasota, Fla.
John M. Graham, '32; September 14, 1989; Darien, Conn.
C Vance Hale, '32; September 23, 1989; Newport News, Va.
Eugene C. Kitendaugh, '32; March 9, 1989; Oneida, N.Y.
D(aniel) Dana Price, '32; October 26, 1989; Houston, Tex.
Peter P. Shelby, '32; February 24, 1989; Los Angeles, Calif.
Robert W. West, '32; November 10, 1988; Silver Spring, Md.
Arthur T. Bishop, '33; November 7, 1989; Lisli, Ill.
Arthur A. Jackman, '33; October 14, 1989; Whitinsville, Mass.
William W. Laird, '33; October 20, 1989; Wilmington, Del.
John C. Barrett, '34; April 2, 1989; Chevy Chase, Md.
Jacob J. Jaeger, '34; December 15, 1987; Cary, N.C.
Graves H. Snyder, '34; October 26, 1989; Summit, N.J.
Albert M. Talbot, '34; May 15, 1989; San Antonio, Tex.
Merrick E. Wheeler, '34; October 25, 1989; Juno Beach, Fla.
Walter Wrigley, '34; November 5, 1989; Wollaston, Mass.
G. Peter Grant, '35; October 2, 1989; Sarasota, Fla.
Edward E. Helwith, '35; October 20, 1989; Rockaway Point, N.Y.
Edgar M. Ferris, '36; October 31, 1989; Old Greenwich, Conn.
Charles W. Shubart, '36; October 23, 1987; Alexandria, Va.
Harry W. Janson, '37; November 14, 1989; Fairhaven, Mass.
Pope A. Lawrence, '37; September 26, 1989; Bethesda, Md.
James K. Cameron, '38; July 5, 1989; Oak Bluffs, Mass.
August E. Kunzelman, '39; March 5, 1989; White Plains, N.Y.
Charles B. Pear, Jr., '39; October 26, 1989; Melbourne, Fla.
Harry E. Trout, Jr., '39; September 27, 1989; Gibsonia, Penn.
Millard Dowell, '40; October 12, 1989; Erie, Penn.



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ALLAN J. GOTTLIEB, '67

Re: Moat Control

David Chandler writes that seeing his brother's solution in print has inspired him to submit answers to the October problems.

Bob High has kindly offered to send us some Go-related puzzles to rotate with the chess and computer offerings. Mr. High is "an officer of the American Go Association and always on the lookout for new ways to promote the game."

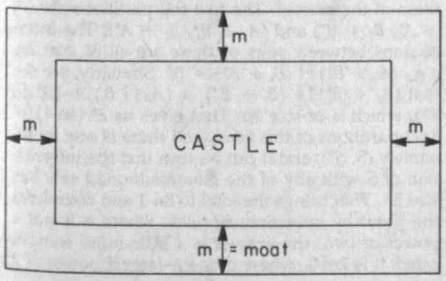
Problems

F/M 1. We begin with a newly arrived chess problem from Warner Smith. Find a legal chess position with the largest possible number of successors, i.e., for which the side to move has the largest possible number of moves.

F/M 2. Jerry Grossman wants you to find two irrational numbers r and s such that r^s is rational and then find two other irrational numbers r and s such that r^s is irrational.

F/M 3. Norman Megill has a cute version of our yearly problem. (Although when you read this problem it will be 1990, I have kept it as 1989.) In formal number theory, there are three primitive operations, + (plus), × (times), and S (successor or "1 plus"), along with a single primitive number, 0 (zero). Any positive integer can be represented by a combination of 0 and the three operations. For example, 67 can be represented by 0 preceded by 67 S's (68 symbols) or more compactly by S(SSS0 × SS(SSSSS0 × SSSS0)) (20 symbols), meaning (1 + (3 × (1 + 1 + (5 × 4))). Parentheses are excluded when counting symbols. What is the shortest representation for the number 1989?

F/M 4. Gary Schmidt and Joseph Horton have a castle surrounded by a rectangular moat and have two 10-foot boards to use to cross the moat.



The boards cannot be nailed or glued together. What is the widest moat they can cross?

F/M 5. Our final regular problem is from that famous riverboat gambler, Gordon Rice. (A) In a gambling game, there are eight balls, numbered 1 through 8, which are shaken up in a jar, and then poured into a funnel leading to a vertical glass tube where they stack on top of each other. Wagers are made, for example, that the 2-ball will be higher in the stack than the 1-ball (even money), or that the 3-ball will be higher than the 2-ball. Another player wants to bet that both things will not happen in a single trial, and offers you 4-to-1 odds. Is this a fair bet? If not, who has the advantage? (B) Unbeknownst to the other players, a cheater succeeds in palming the standard 1-ball and substituting another which is twice as heavy. How should he then bet to take advantage of his trick?

Speed Department

SD 1. Speedy Jim Landau wants you to interpret "No one under C_8H_{18} admitted!"

SD 2. L.R. Steffens needs to punctuate 123456789 so that it will describe an event that happened twice in Times Square during this century and will also happen twice in the next century.

Solutions

OCT 1. We begin with a bridge problem from Tom Harriman.

NORTH
♠ A J 7 5
♥ A Q 7 4 2
♦ A J
♣ 5 4

WEST
♠ 8 6
♥ 10 8 2
♦ 10 8 7 5 3
♣ 9 8 7

EAST
♠ Q 10 9 2
♥ K 9 6
♦ K Q 6 4 2
♣ 10

SOUTH
♠ K 4 3
♥ J 5
♦ 9
♣ A K Q J 6 3 2

How does South play to make seven clubs against best defense after the opening lead of the spade 8?

The following solution (his first submitted in 17 years of reading *Tech Review*) is from Andy Wasserman:

A quick look at declarer's assets show eleven tricks off the top, with potential losers in spades and hearts. Since we spurn losing finesses, and since throw-ins are seldom effective in grand slams (unless we can convince an opponent to revoke), we immediately consider a squeeze. Moreover, needing two tricks, we need a repeating squeeze—in this case, a repeating triple squeeze against East.

If a triple squeeze is going to repeat against the best defense, there must be two threats in the upper hand (South). Otherwise, on the squeeze card, the defender being squeezed can simply establish the threat in the upper hand. This gives declarer one trick, but not two, since declarer is left with two threats in the lower hand (North). When declarer then plays his established winner, he must discard from the lower hand before the defender, squeezing himself.

In addition, as with any squeeze, there must be an entry to the established threat. So, even with two threats in the lower hand, the best defense can prevent a triple squeeze from repeating by establishing the lower threat if there is no entry to one of the upper threats.

So, to make this hand via a repeating triple squeeze against East, all we need is one threat in the North hand accompanied by an entry in its suit and two threats in the South hand accompanied by an entry in one of the two suits. It then becomes obvious to the most casual observer that the threats must be the jack of diamonds, jack of hearts, and four of spades. The ace of diamonds provides the entry to the North hand, but the only entry to the South hand outside of trump is the king of spades. Ergo, the king of spades must be preserved at all costs.

Therefore, the key play comes at the first trick, at which point South must rise with North's ace of spades. This is followed by the ace of hearts—Vienna Coup to establish the jack as a threat—and six clubs. On one of the long clubs, North must discard the queen of hearts.

The position at this point is:

♠ 5
♥ 4 2
♦ A J
♣ —

Irrelevant

♠ Q 10
♥ K
♦ K Q
♣ —

♠ K 4
♥ J
♦ 9
♣ 2

On the last club, North can pitch a heart, but East is finished. If he pitches a spade, South cashes two spade winners, throwing a heart from North, and inflicts a red suit simple squeeze for the thirteenth trick. If East pitches his heart, South cashes his heart winner and squeezes East in spades and diamonds. Finally, if East pitches a diamond, South crosses in diamonds, and the jack of diamonds squeezes East in the majors.

Two things are noteworthy. First, the triple squeeze functions against East because West holds only two spades. Giving West the deuce of spades and removing a card from any other suit kills the



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012.

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Rod Campbell '81
Randy Frazier '72
Don R. Widrig '65

squeeze, because West's spade eight takes care of South's threat and allows East to unguard the suit. Second, an opening diamond lead defeats the contract. A triple squeeze will still work against East, but it will not repeat because it removes a key entry from North. East will unguard spades, giving South one trick, but the resulting red suit squeeze against East fails for lack of entries.

Also solved by Francis Leahy, Amy Lowenstein, Robert Zier, Alex Halberstadt, John Stiehler, Robert Bart, Chip Palmer, David Chandler, John Chandler, Charlie Larson, Winslow Hartford, Donald and Nancy Noble, Eugene Biek, Richard Hess, Carey Rappaport, Matthew Fountain, Dan Frankel, and the proposer.

OCT 2. Gordon Rice supposes that some time in the (not too distant?) future, the art of pencil and paper arithmetic has been forgotten. Also, your computer is giving off smoke. With no way to add, subtract, multiply, or divide except an 8-digit calculator, can you evaluate the following expressions?

$$3 \cdot 180997^2 - 313496^2$$
$$3 \cdot 37467^2 - 64896^2$$

The following solution is from my children's honorary grandfather, Phelps Meaker:

$$\begin{aligned}
3 \cdot 180997^2 &= 3(180^2 \cdot 1000 \cdot 1000 + 2 \cdot 180 \cdot 1000 \cdot 997 + 997^2) \\
&= 3(32{,}400 \cdot 1000 \cdot 1000 + 358{,}920 \cdot 1000 + \\
&\quad 994 \cdot 1000 + 9) \\
&= 98{,}279{,}742 \cdot 1000 + 27 \\
313496^2 &= 313^2 \cdot 1000 \cdot 1000 + 2 \cdot 313 \cdot 1000 \cdot 496 + 496^2 \\
&= 97{,}969 \cdot 1000 \cdot 1000 + 310{,}496 \cdot \\
&\quad 1000 + 246 \cdot 1000 + 16 \\
&= 98{,}279{,}742 \cdot 1000 + 16 \\
3 \cdot 180997^2 - 313496^2 &= 98{,}279{,}742 \cdot 1000 - 98{,}279{,}742 \cdot \\
&\quad 1000 + 27 - 16 = 11 \text{ Q.E.D.}
\end{aligned}$$

$$\begin{aligned}
3 \cdot 37467^2 &= 3(374^2 \cdot 100 \cdot 100 + 2 \cdot 374 \cdot 100 \cdot 67 + 67^2) \\
&= 3(139{,}876 \cdot 100 \cdot 100 + 50{,}116 \cdot 100 + \\
&\quad 44 \cdot 100 + 89) \\
&= 42{,}113{,}280 \cdot 100 + 267 \\
64896^2 &= 648^2 \cdot 100 \cdot 100 + 2 \cdot 648 \cdot 100 \cdot 96 + 96^2 \\
&= 419{,}904 \cdot 100 \cdot 100 + 124{,}416 \cdot 100 + 92 \cdot \\
&\quad 100 + 16 \\
&= 42{,}114{,}908 \cdot 100 + 16 \\
3 \cdot 37467^2 - 64896^2 &= (42{,}114{,}908 \cdot 100 - \\
&\quad 42{,}113{,}280 \cdot 100 + 16 - 267)(-1) \\
&= (1628 \cdot 100 + 16 - 267)(-1) \\
&= -162{,}549 \text{ Q.E.D.}
\end{aligned}$$

Also solved by Robert Bart, David Chandler, Jock Young, Harry Garber, John Chandler, Charlie Larson, Thomas Harriman, Jim Martin, Winslow Hartford, Richard Hess, Carey Rappaport, Matthew Fountain, Bob High, Dan Frankel, and the proposer.

OCT 3. John Rule has a three-digit number that, when divided by the product of its digits, yields as quotient the hundredth digit. Rule wants you to find this number and show that it is unique.

The following solution is from Matthew Fountain: The number is 735. Let A, B, and C represent the three digits so that ABC = (100A + 10B + C)/A. As $10B + C < 100$, we may write $100/A < BC < (100A + 100)/A^2$. BC must also be a product of two single-digit integers. When A is taken to be 9, then $11 < BC < 13$. BC has only the possibility of being 12. Noting that A^2BC equals the three-digit number, we calculate $(9^2)(12) = 972$, yielding B = 7 and C = 2. As $7 \times 2 = 14$, not 12, 972 is not a solution. We next try smaller values for A, having exhausted all possibilities for A = 9. The results are in the following table.

A = 8, 12<BC<15, (64)(14) = 896,
A = 7, 14<BC<17, (49)(15) = 735, (49)(16) = 784
A = 6, 16<BC<20, (36)(18) = 648
A = 5, 20<BC<24, (25)(21) = 525
A = 4, 25<BC<32, (16)(27) = 432, (16)(28) = 448
A = 3, 33<BC<45, (9)(35) = 315, (9)(36) = 324, (9)(42) = 378
A = 2, 50<BC<75, (4)(54) = 216, (4)(56) = 224, (4)(63) = 252, (4)(64) = 256, (4)(72) = 288
A = 1, 100<BC<200

The only case where the product of the last two digits of a tabulated product equals BC is A = 7, BC = 15, and (49)(15) = 735. We do not need to test BC's that are a multiple of 10 or contain prime factors larger than 9.

Also solved by Edward Dawson, Robert Bart, David Chandler, Harry Garber, Mary Lindenberg, Leonard Nissim, Thomas Harriman, Winslow Hartford, Donald Savage, Avi Ornstein, Richard Hess, Carey Rappaport, Gordon Rice, Steven Feldman, and Bob High.

OCT 4. David Evans notes that on an 8×8 checkerboard, if two squares of the same color are removed, it is impossible to cover the remaining 62 squares with 31 1×2 tiles (since each tile covers one white and one black square). Is the converse true, i.e., if you remove 2 squares of opposite colors, can the remaining 62 squares always be covered by 31 1×2 tiles?

The following solution is from Al Zobrist:
Let "coverable" be the property that any 2 squares of the opposite color can be removed and the board can be covered with 1 × 2 tiles. A 2 × 2 checkerboard is obviously coverable. Suppose that an n × n checkerboard (n even) is coverable. Augment this to the next larger even-sided checkerboard by surrounding it with a single layer of squares. Three cases show that the larger checkerboard is coverable.

1. The removed squares are both interior. Cover the interior (it is n × n), and cover the outside (it has 4n + 4 squares arranged linearly).
2. The removed squares are both exterior. Cover the interior (each row is even and linear). The exterior removed squares are opposite in color, hence are separated by even numbers of squares both ways.
3. One of each. Suppose the interior removed is white. Remove another interior black and an adjacent exterior white. Cover the interior as in case 1 and the exterior as in case 2, then unremove the additional removed squares and cover them with one tile.

By induction, any n × n checkerboard is coverable if n is even and positive.

Also solved by Robert Bart, Jim Roskind, David Chandler, Richard Hess, Thomas Harriman, Winslow Hartford, Carey Rappaport, Matthew Fountain, Gordon Rice, Ken Rosato, Bob High, and the proposer.

OCT 5. Chuck Coltharp poses the following partitioning question. Let S be a finite set of size 4n and let P be a collection of partitions of S, each of which partitions S into two disjoint sets of size 2n. Let the i^{th} partition be the two sets A_i and B_i. We require that, for $i \neq j$, $A_i \cap B_j$ is of size n. The question is how large can P be, that is for each n what is the largest number of partitions that can be found satisfying the above properties?

I will print two solutions to this difficult problem since they have rather different characters. John Chandler submitted a direct calculation for sizes that are powers of two and Bob High related the problem to Hadamard matrices. Chandler writes: P can be of size 4n-1 when n is a power of two. We can show this by induction. First, it is simple to see that there are exactly 3 partitions of 4 into 2 + 2 and that all three belong. Then, suppose we take a set S of size 4n and add S^* to it. $S + S^*$ has size 8n. We have 4n-1 suitable partitions of S and 4n-1 matching partitions of S^*. We can construct two full partitions from the two half-partitions by combining the two halves of each with the corresponding or opposite halves of the other, i.e., take (A_i, B_i) to be a partition of the first half and (A_i^*, B_i^*) to be a partition of the second. The two full partitions are $(A_i + A_i^*, B_i + B_i^*)$ and $(A_i + B_i^*, B_i + A_i^*)$. The intersections between pairs of these are all of size 2n, e.g., $(A_i + B_i^*) \cap (B_i + B_i^*) = B_i^*$. Similarly, we see that $(A_i + B_i^*) \cap (B_j + B_j^*) = (A_i \cap B_j) + (B_i^* \cap B_j^*)$, which is of size 2n. That gives us 2* (4n-1) = 8n-2 partitions of this kind, and there is one more, namely (S, S^*), and it can be seen that the intersection of S with any of the aforementioned sets has size 2n. That brings the total to 8n-1 and completes the proof by induction. For sets where n is not a power of two, the answer is a little more complicated: it is 2m-2, where m is the largest power of 2

that divides n. To see how this is so, we look again at adding two sets together, but this time sets of different sizes. If one size is a multiple of the other, the larger set will have a larger collection of partitions, but we won't be able to match them all with corresponding partitions of the smaller set. In short, we can only get twice as many partitions of the combined set as there are of the smaller set.

High's solution follows:

This turns out to be quite interesting. If P is a collection of k partitions of a set S with $4n$ members meeting the problem conditions, I can prove that the *maximum possible* value for k is $4n - 1$ (see below). However, to show that this maximum is *attained* for every n is in fact, if I am not mistaken, equivalent to an open problem in combinatorial theory!

First, let's establish the upper bound $k \leq 4n-1$. This part of the problem has a pretty geometric interpretation: Let each partition be represented by a vector of 1's and -1's, with $2n$ 1's and $2n$ -1's in each vector. By hypothesis, any two vectors will have 1's in common in exactly n places, and -1's in common in exactly n places. Thus, for any two such vectors (a_i) and (b_i), we will have

$$\sum_{i=1}^{4n} a_i b_i = 0$$

That is, the vectors are *mutually orthogonal*.

Each partition, represented as a vector of 1's and -1's, can be considered as a point in $4n$-space. By flipping signs, if necessary, we can arrange that for a chosen $s \in S$, each vector will have a "1" in the place represented by s. We can then drop that place from all the vectors, resulting in a set of k vectors in $(4n - 1)$-space. Now, any two such vectors are *equidistant* by the conditions of the problem—they differ in exactly $2n$ places, so they are all exactly $2\sqrt{2n}$ units apart. And there is *another* point in $(4n - 1)$-space which is equidistant from each of them—the point $(1, \ldots, 1)$. These $k + 1$ points therefore form the vertices of a k-simplex. This shows immediately that there can't be more than $(4n - 1)$ such partitions, since one can't embed a $4n$-simplex in $(4n - 1)$-space!

This says that if we *can* find a collection of $k = 4n - 1$ partitions, they will give rise to a $(4n - 1)$-simplex embedded in the $(4n - 1)$-dimensional cube. Conversely, if we can find a simplex embedded in the $(4n - 1)$-dimensional cube, it will give us a solution to our problem. So the problem boils down to the geometric question: for which dimensions can one embed a simplex in the cube?

As far as *realizing* the maximum value of $4n - 1$, this turns out to be equivalent to the problem of the *existence of Hadamard matrices of every order* $4n$. A **Hadamard matrix** is a square m-by-m matrix A with the property that $a_{ij} = \pm 1$ for all i j and $AA' = mI$. One can show that if A is a Hadamard matrix, then $m = 4n$. (See Ian Anderson, *A First Course in Combinatorial Mathematics, 2nd Edition*, Oxford, 1988, for example.) Now, if a Hadamard matrix exists for a given value of $m = 4n$, it proves that $k \geq 4n - 1$ in our problem (since the rows or columns of the matrix other than $(1, \ldots, 1)$, being orthogonal, define a collection of partitions meeting the problem conditions). But it is *not known* (at least, as of the publication of Anderson's book in 1988) whether Hadamard matrices exist for every possible m; according to Anderson, 428 is the first unknown case. So it's hard for me to believe that the proposer of this problem knows the answer for $4n = 428$!

It's easy to come up with Hadamard matrices (and hence solutions to our problem) for small values of n. For n = 1, for example, one has:

```
+1 +1 +1 +1
+1 +1 -1 -1
+1 -1 +1 -1
+1 -1 -1 +1
```

For n = 2,

```
+1 +1 +1 +1 +1 +1 +1 +1
+1 +1 +1 +1 -1 -1 -1 -1
+1 +1 -1 -1 +1 +1 -1 -1
+1 +1 -1 -1 -1 -1 +1 +1
+1 -1 +1 -1 +1 -1 +1 -1
+1 -1 +1 -1 -1 +1 -1 +1
+1 -1 -1 +1 +1 -1 -1 +1
+1 -1 -1 +1 -1 +1 +1 -1
```

And for n = 3, (replacing ± 1 with 1 and 0 for legibility)

```
1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 0 0 0 0 0 0
1 1 1 0 0 0 1 1 1 0 0 0
1 1 0 1 0 0 1 0 0 1 1 0
1 1 0 0 1 0 0 1 0 1 0 1
1 1 0 0 0 1 0 0 1 0 1 1
1 0 1 1 0 0 0 1 0 0 1 1
1 0 1 0 1 0 0 0 1 1 1 0
1 0 1 0 0 1 1 0 0 1 0 1
1 0 0 1 1 0 1 0 1 0 0 1
1 0 0 1 0 1 0 1 1 1 0 0
1 0 0 0 1 1 1 1 0 0 1 0
```

Given one Hadamard matrix, it's easy to "bootstrap" your way to larger ones. Given any two Hadamard matrices A and B, of orders m and n respectively, just substitute A for 1 and $-A$ for -1 in B, and a new Hadamard matrix of order mn will emerge. Thus, it's easy to answer the problem completely for $n = 2^k$, for example, and for certain other values. (I had constructed these examples, and found a solution for $n = 12$, before going to Anderson.)

In speculating about the existence of a Hadamard matrix of every order $4n$, it is natural to think about the symmetries of the corresponding embedded simplex. Starting from the vertex $(1, \ldots, 1)$, take *any* other vertex v of the $4n - 1$-cube differing from this in exactly $2n$ places. If an embedded simplex exists, there should be a symmetry of the $4n - 1$-cube fixing $(1, \ldots, 1)$ and carrying the vertex v cyclically into each of the $4n - 1$ vertices of that simplex (other than $(1, \ldots, 1)$). This will be a rigid motion σ of the cube (and simplex) with the property that the distance from v to $\sigma(v)$ will always be exactly $2\sqrt{2m}$. Since such symmetries amount to permutations of the coordinate axes, this is equivalent to finding a permutation of $4n - 1$ elements with the property that for a given subset K consisting of $2n - 1$ elements, we have $K \cap \sigma^k(K)$ of size exactly $n - 1$ for all k. For example, the permutation (1425673) does the job for $n = 2$.

Also solved by David Chandler, Carey Rappaport, Matthew Fountain, and the proposer.

Better Late Than Never

1987 N/D 5. Thomas Harriman sent us a rigorous solution to this (so-called Mnage) problem. Copies are available from the editor.

1989 F/M 5. Albert Mullin notes that the largest Mersenne prime found to date is much closer to $2^{216,091} - 1$ than to $2^{19,937} - 1$ and that there are asymptotically $n/\log n$ primes less than n.

APR 4. Thomas Harriman sent us a more analytic solution; Albert Lazzarini has responded.

M/J 1. Robert Bart points out White's second move in the solution to part A is illegal and provides us with the following correct version.

	Black	White
1.	N-e4ch	K-d1
2.	N-c3ch	PxN
3.	B-e1	P-c4
4.	P-h1(R)	P-c5
5.	R-h2	P-c6
6.	RxP	P-c7
7.	R-a7	P-c8(Q) mate

JUL 2. John Prussing had responded in a timely fashion but I am sorry to say that I misplaced his letter.

JUL 3. Dimitri Daskalopoulos, L.J. Lipton, and James Conant have responded.

JUL 5. Thomas Harriman has responded.

Proposers' Solutions to Speed Problems

SD 1. An octane rating

SD 2. 1:23:45, 6/7/89. The time on June 7, 1989 am and pm, and on June 7, 2089.

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MIT LIFE INCOME FUNDS

CHAPLIN TYLER

HOME: Hockessin, Delaware

CAREER: Having served as a medic in France during World War I, Mr. Tyler came to MIT as a research associate and in 1923 was awarded a master's degree in chemical engineering. In 1927, on the basis of *Chemical Engineering Economics*, a book he wrote while an associate editor for McGraw-Hill, DuPont offered him a job in research. He stayed with DuPont until 1963, moving on to sales development, public relations and corporate development. During World War II, he was the director of public relations for Remington Arms, a DuPont subsidiary. After retiring from DuPont, he served as a corporate consultant for Coca-Cola for 15 years.

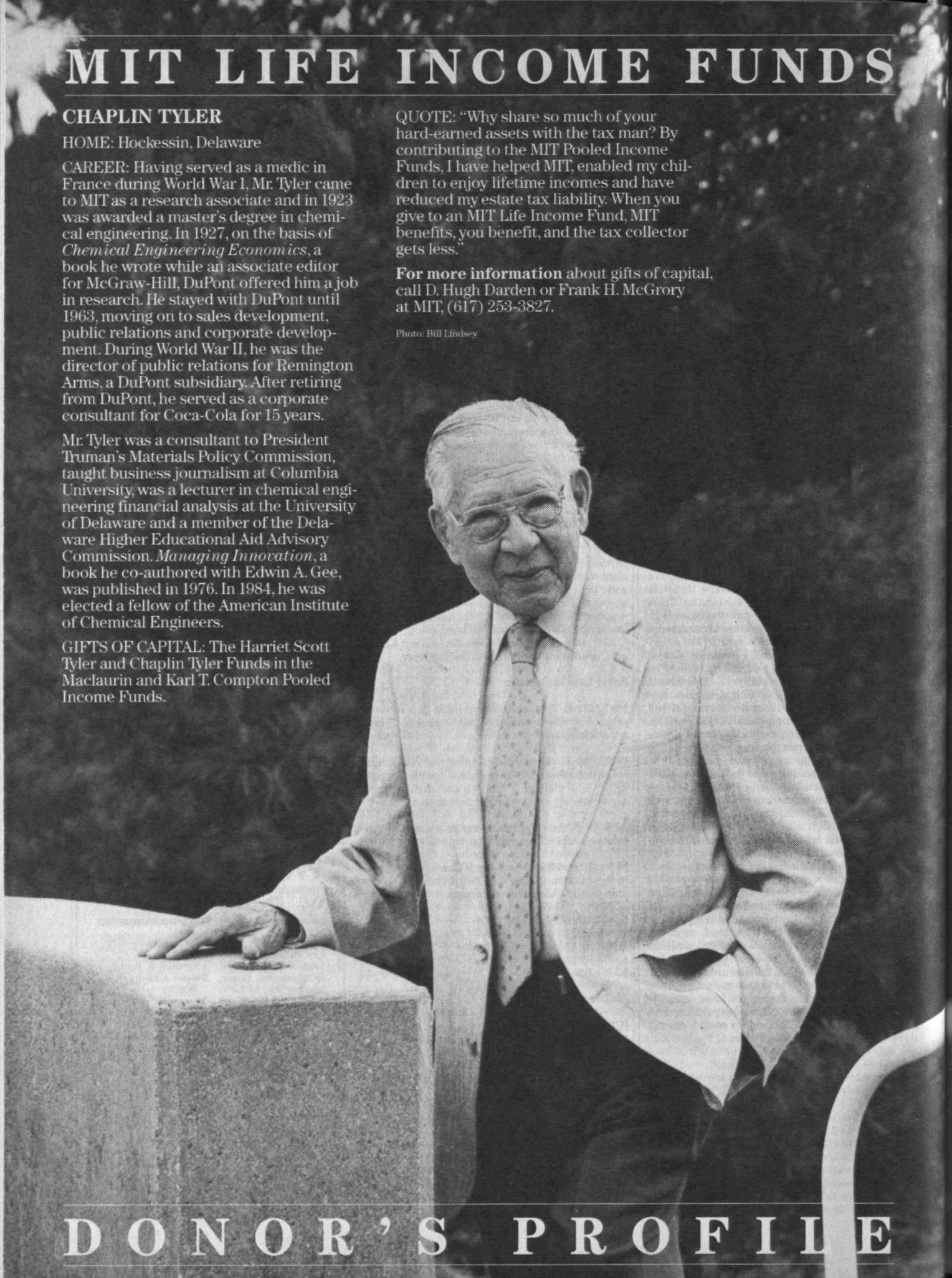
Mr. Tyler was a consultant to President Truman's Materials Policy Commission, taught business journalism at Columbia University, was a lecturer in chemical engineering financial analysis at the University of Delaware and a member of the Delaware Higher Educational Aid Advisory Commission. *Managing Innovation*, a book he co-authored with Edwin A. Gee, was published in 1976. In 1984, he was elected a fellow of the American Institute of Chemical Engineers.

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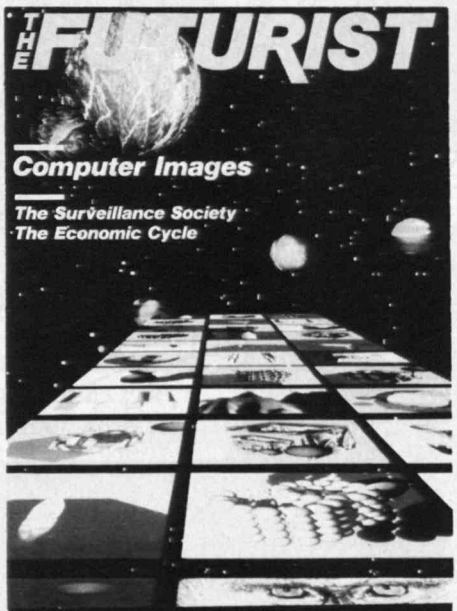
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This map shows the northern half of the zone that ruptured during last October's magnitude 7.1 earthquake near Santa Cruz, Calif. In 1988, earthquake experts estimated that of all the fault segments in northern California, this one was the most likely to experience a major quake.

By Allan G. Lindh

Earthquake Prediction Comes of Age

THE magnitude 7.1 earthquake that shook the San Francisco Bay Area last October was a dramatic reminder of nature's destructive power. But in addition to its heavy cost in human lives and property, the Loma Prieta quake (named after the mountain near its epicenter in the Santa Cruz Mountains) was a sign of recent progress in the uncertain science of earthquake prediction.

In the last decade, scientists have begun to estimate the long-term probability of major earthquakes along the San Andreas fault. In 1985, the U.S. Geological Survey (USGS), where I work, issued the first official U.S. government earthquake prediction, based on research along a heavily instrumented 25-kilometer section of the fault in sparsely populated central California. Known as the Parkfield segment, after a nearby town, this section of the San Andreas had experienced its last big earthquake, a magnitude 6, in 1966. According to our estimate, there is a 95 percent chance that another one will occur at Parkfield by 1993.

In 1988 a working group of California earthquake experts, using new geologic data and careful analysis of past earthquakes, estimated probabilities of major quakes along the entire San Andreas. The segment that the Loma Prieta quake struck was given the highest probability of any in northern California—a 30 percent chance over the next 30 years.

What's more, there were indications in the 16 months before the Loma Prieta earthquake that something was happening along the segment. In June 1988 and again in August 1989, a magnitude 5 quake hit the northwest end of the segment, west of San Jose. This led the state of California, acting on the advice of the USGS, to issue public advisories warning that the probability of a magnitude 6.5 earthquake had increased.

Needless to say, we were unable to predict the exact time of the Loma Prieta



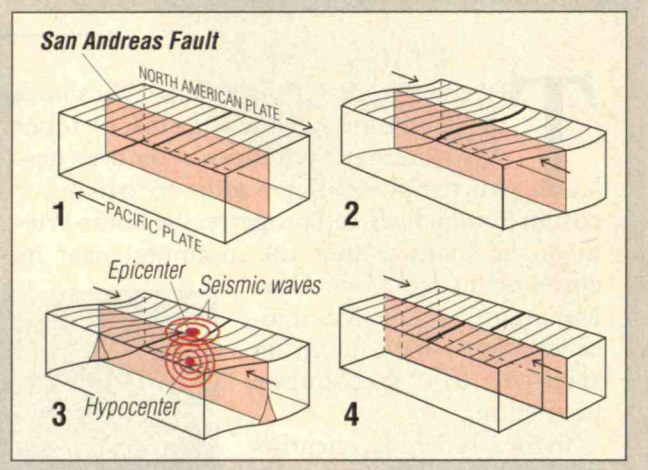
Predicting earthquakes remains difficult, but scientists are making progress. The result may someday be a warning system that could save lives.

DRAWING: DEBORAH PERUGI DESIGN; PHOTO: ERIC SANDER/GAMMA LIAISON

Over the last decade, geologists have created a model for estimating the likelihood of major earthquakes along the San Andreas fault.

MAGNITUDE	ENERGY RELEASED (MILLIONS OF ERGS)	ENERGY EQUIVALENCE
−2	600	100 watt light bulb left on for a week
−1	20000	Smallest earthquakes detected at Parkfield
0	600000	Seismic waves from one pound of explosives
1	20000000	A two-ton truck traveling 75 miles per hour
2	600000000	
3	20000000000	Smallest earthquakes commonly felt
4	600000000000	Seismic waves from 1,000 tons of explosives
5	20000000000000	
6	600000000000000	Parkfield earthquakes: 1934, 1966, 19?
7	20000000000000000	
8	600000000000000000	1906 San Francisco (magnitude = 8.3)
9	2000000000000000000	Largest recorded earthquake (magnitude = 8.9)
10	60000000000000000000	

The Richter scale (left) measures earthquake magnitude. For each unit, the amplitude of ground motion increases by a factor of 10. The energy released as seismic waves increases even faster—by a factor of about 30.



Earthquakes happen as the earth's crustal plates move by each other (1). This deforms the rock straddling the fault (2), which eventually can no longer contain the strain energy (3). The fault then slips (4).

earthquake—as we have so far been unable to predict precisely the time of any quake in California. But even in the more difficult area of short-term prediction, we have made some progress. Since 1985, the USGS, the state of California, and universities from around the world have been involved in a multi-million-dollar experiment in earthquake prediction at Parkfield. Our goal is to provide a warning in the weeks, days, or even hours before the next magnitude 6 earthquake there, which we believe will occur within two to three years.

A quake of that magnitude on the Parkfield segment will probably not kill anyone. Historically, there have never even been any significant injuries or damage from earthquakes there. In this respect, our warning system is truly experimental—an attempt to find out whether we can predict the next Parkfield quake, how officials will use our information, and how the general public will react to an announcement that a quake may be about to occur.

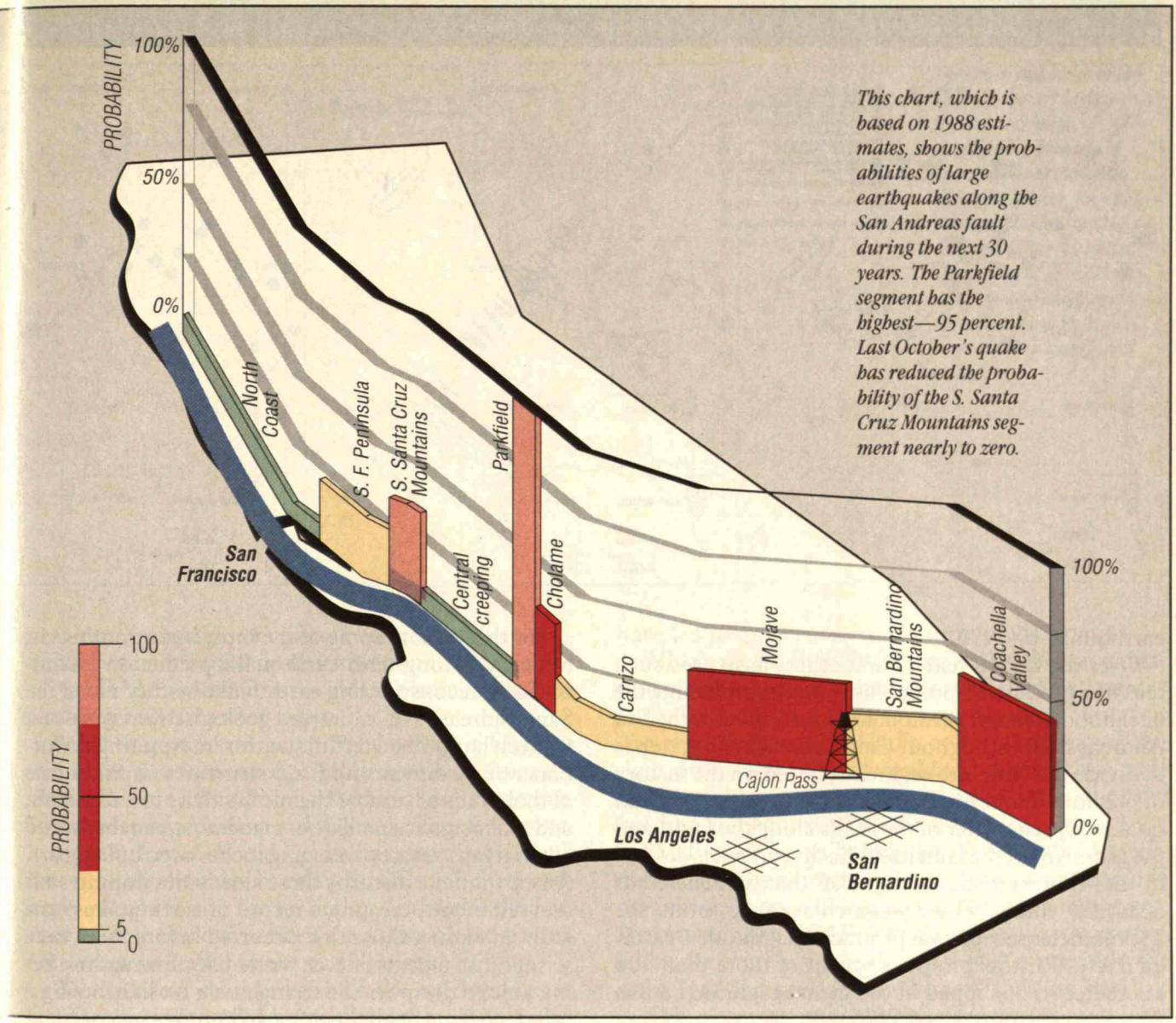
One encouraging sign is that the Parkfield prediction experiment has already prompted public officials to start creating the social and political infrastructure necessary if earthquake prediction is to be used someday to save lives. In cooperation with the California Office of Emergency Services, we have established a warning system to alert the public when activity along the fault in Parkfield suggests that an earthquake may be imminent.

ALLAN G. LINDH is a seismologist in the Office of Earthquakes, Volcanoes, and Engineering at the U.S. Geological Survey in Menlo Park, California. He has a Ph.D. in geophysics from Stanford University and has been involved in earthquake-prediction efforts for 15 years. He and his family live in an old ranch house in the Santa Cruz Mountains about half a mile from the San Andreas fault.

However, even if we successfully predict the next earthquake at Parkfield and are able to warn residents, that doesn't mean we could do the same in Los Angeles or San Francisco, where the consequences of a major earthquake would be far higher. But if successful, the Parkfield prediction experiment and warning system will provide a model for future attempts at short-term prediction in the urban areas where it could make the most difference.

How Earthquakes Happen

Geologists have understood for about 100 years the basic mechanism that produces large earthquakes. Over time, motion on either side of a fault deforms the rock that straddles it. The strain energy accumulates until the rock can no longer contain it, causing slip on the fault. Then, much as tension is released when a coil spring is compressed until its mechanism breaks, energy



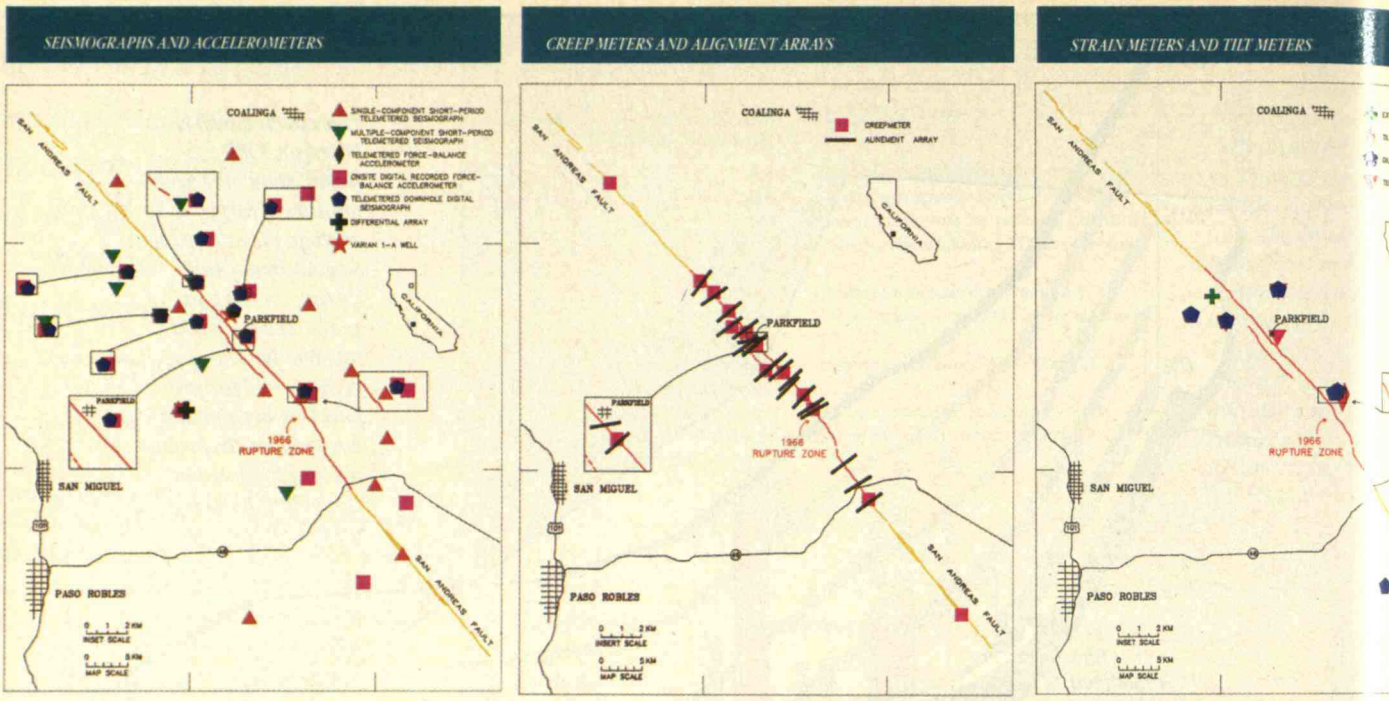
radiates from the rock adjoining the portion of the fault that slips—which can lead to damage as much as hundreds of miles away. Afterward, the cycle of strain accumulation starts over again.

This simple model was developed by Grove Karl Gilbert of the USGS in the 1880s and refined by Harry Reid of Johns Hopkins University in his research on the 1906 San Francisco earthquake. Plate-tectonics theory, developed in the 1960s and '70s, helps explain what fuels the process of strain accumulation and slip, but the Gilbert-Reid model forms the basis of long-term earthquake prediction to this day.

Theoretically, observing strain changes in the rocks adjacent to a fault should make it possible to predict the time of the next earthquake at that site. Graphing the cycle of strain accumulation and failure at a point on a fault where large earthquakes have occurred produces a sawtooth curve. Time is plotted along the horizontal axis and stress on the fault plane along the vertical axis, so that a large earthquake shows up as a sharp vertical drop. When researchers know the average length of time between major earthquakes at a site, they can estimate the time of the next major quake simply by adding that average to the time of the last one.

The Parkfield segment of the San Andreas provides striking confirmation of this simple model. Since the late 1880s, magnitude 6 earthquakes have occurred at Parkfield on an average of once every 22 years—in 1881, 1901, 1922, 1934, and 1966. What's more, historical records and seismographic data from as far away as Holland indicate that the last two earthquakes were essentially identical. The same portion of the fault slipped, and the amount of slip was the same. Even the details of how the two quakes began are remarkably similar. A simple extrapolation suggests that the next event should have come in 1988, plus or minus a few years. This led to the 1985 USGS prediction that Parkfield has a 95 percent chance of experiencing another

DRAWINGS: DEBORAH PERUGI DESIGN/FROM USGS DATA



earthquake by 1993.

Over the last 10 years, I and others have used such reasoning to create a probabilistic model estimating the likelihood of major earthquakes for sections of the San Andreas fault throughout California. The first step is to divide the fault into segments, based on the history of previous major earthquakes, the locations of small quakes, the character of the rocks along the fault, and the geometry of the fault itself. Each segment is defined by the "characteristic earthquake" that we believe has occurred there. These segments range from the 25-kilometer section that produces magnitude 6 earthquakes at Parkfield to the segment of more than 400 kilometers that slipped in the great magnitude 8 San Francisco earthquake of 1906.

The second step in creating our model is to use whatever information is available to estimate how frequently characteristic earthquakes will occur on a given segment. One source is the historic record of earthquakes on the segment, which in California is unfortunately very short. Another is the geologic record, which can be reconstructed in some cases as far back as 2,000 years. A third indicator is the amount of slip that occurs in the characteristic earthquake. We divide this figure by the slip rate—the rate at which the plates are sliding by one another across the segment—to estimate the time until the next event.

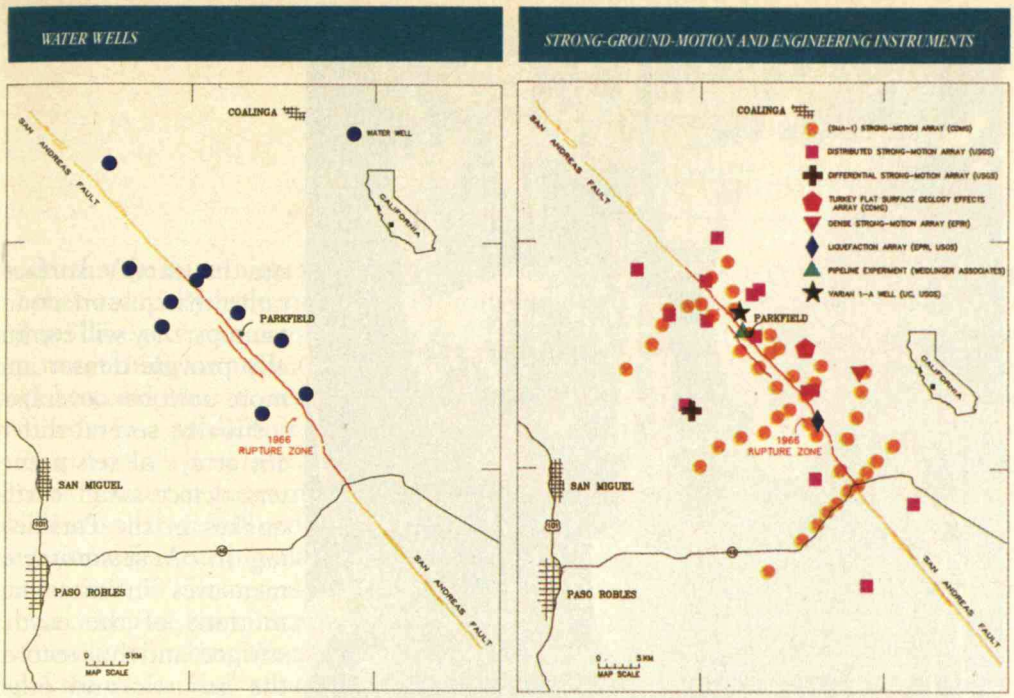
Obviously, the accuracy of our estimates depends upon the quality and quantity of data we have for each fault segment. Because geologists have been intensively studying the Parkfield segment for some 30 years, and because five characteristic earthquakes have occurred there since 1881, we have an abundance of solid information to draw on. But the same is not true for many other segments of the fault.

For this reason, some of the most important recent research in long-term earthquake prediction has focused on reconstructing earthquake history along the San Andreas. For example, geologist Kerry Sieh at Caltech has refined techniques for interpreting disturbances in sediments and soil structures. It takes tens of thousands of years of chemical activity to create soils, and sediments accumulate in marshes, stream beds, and alluvial fans at rates averaging inches over 1,000 years. An earthquake disturbs these slowly developing soils and sediments, creating a record of earthquakes on a fault, including those that occurred before there were seismic instruments or even written documentation. Being able to decipher the changes is a bit like having a tape recording of all the past earthquakes in a particular area. With extreme care and patience, Sieh and his students and colleagues have reconstructed a history of earthquakes along some segments of the San Andreas that stretches back as far as 2,000 years.

Armed with such information, we can begin to estimate the probabilities of future earthquakes. For example, the Coachella Valley segment of the San Andreas, south of San Bernardino, has not had a major earthquake in at least 200 years. But Sieh and others have discovered evidence suggesting that major earthquakes occur there every 200 to 300 years, and that the last one happened before 1700. Thus, we estimate that there is about a 40 percent chance of a major earthquake on this segment in the next 30 years.

Short-Term Prediction

Of course, short-term predictions are considerably more difficult to make than long-term ones. We do not yet know whether it is possible on a routine basis to



These are just some of the state-of-the-art instruments used in the earthquake-prediction experiment at Parkfield. The information they provide could allow the U.S. Geological Survey to issue a warning of the next magnitude 6 earthquake there in the weeks, hours, or even minutes before it occurs.

provide a warning immediately before a major earthquake, when it would do the most good. But research at Parkfield, combined with evidence from around the world, gives reason for hope.

Predicting an earthquake right before it happens would require some recognizable departure from the simple linear accumulation of strain along a segment. Laboratory experiments and theoretical models strongly suggest that we should see preliminary slip on a fault before an earthquake, but they do little to help us estimate either the size or the timing of the slip that occurs in real geologic materials at the pressures and temperatures found in the earth's crust.

We do know that about half the earthquakes in California are preceded by foreshocks—minor quakes that occur in the minutes, hours, or days before the main event. Consider the analogy to bending a rotten stick. If you bend it slowly, you'll see small cracks develop and hear it starting to give before it breaks.

So far, foreshocks are impossible to distinguish from general background seismicity. We don't know that they are foreshocks until after the fact. However, studying the history of a fault segment in great detail may allow us to identify certain "sensitive spots" where foreshocks and other warning signs are likely to occur. By carefully monitoring these spots, we may learn to detect, measure, and interpret the signals of a forthcoming earthquake.

Indications from previous Parkfield earthquakes are promising. For example, two weeks before the 1966 quake, Japanese seismologists visiting Parkfield discovered cracks in the fault zone. In the years since, some scientists have suggested that these cracks were a sign that the fault had started to slip a couple of weeks before the earthquake—just the sort of thing that might have led to an accurate short-term prediction.

What's more, 10 hours before the quake, an irrigation pipe broke near where it crossed the San Andreas fault. By itself, that doesn't prove anything. This is a very complex part of the fault, and it is creeping all the time. Still, such an event could indicate that the fault had not only started to slip weeks before the earthquake but had accelerated in the final hours.

Finally, just hours before the 1966 Parkfield earthquake, a series of foreshocks occurred, including one magnitude 5 only 17 minutes before the main event. Interestingly, the 1934 Parkfield earthquake was preceded by the same magnitude foreshock at precisely the same spot and precisely the same 17-minute interval.

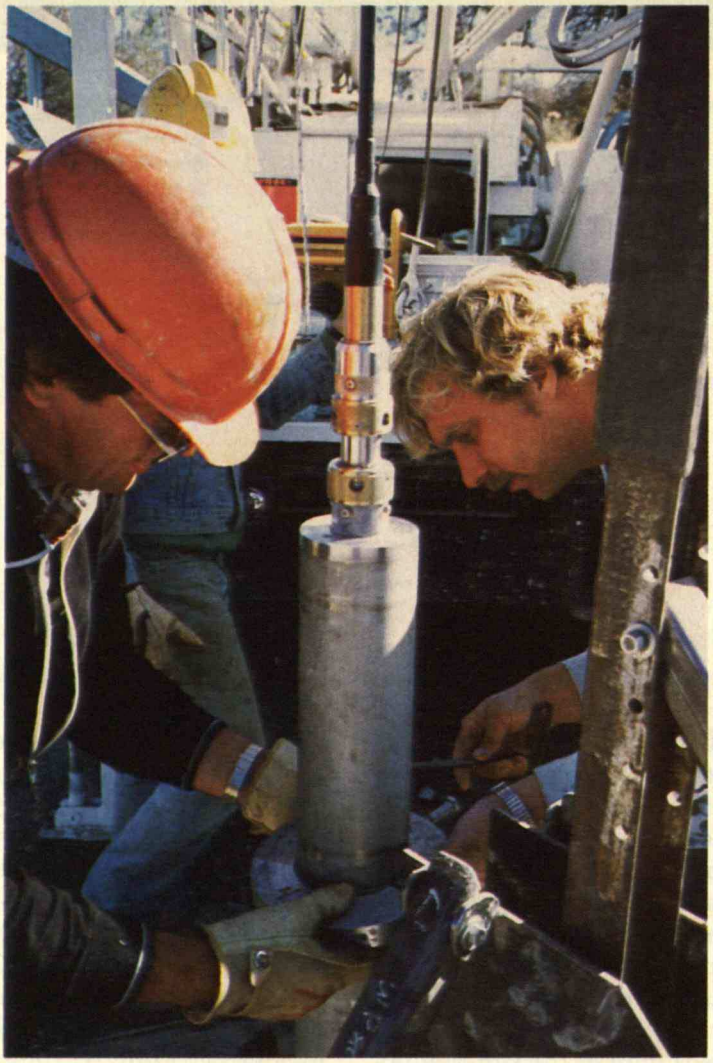
This circumstantial evidence suggests that at least some earthquakes are the product of a relatively well behaved and "periodic" physical system. If so, then given enough time and effort, we should be able to understand this system. And if the same chain of events occurs before the next Parkfield earthquake, we should be able to issue a short-term prediction.

This is the goal of the experiment now taking place at Parkfield. The USGS (in conjunction with the University of California, the state's Division of Mines and Geology, and investigators from many institutions around the world) continuously monitors seismicity and deformation along the San Andreas in the Parkfield area. The instrumentation array is the best of its kind and allows us to record earthquakes from below magnitude 0 (roughly equivalent to the energy release of a few sticks of dynamite) up to magnitude 6. On average, we record half a dozen earthquakes every week. A large part of our effort focuses on those small earthquakes that occur in what we call the "preparation zone," where the 1966 earthquake started and where

DRAWINGS: USGS

the foreshocks were located.

Three major categories of instruments measure activity at the Parkfield site. Strain meters constitute the backbone of our monitoring efforts. They sense changes in strain—that is, the deformation of rock—at a single point. To produce useful information, strain meters need to work at a precision of about 1 part per billion. In other words, they must be sensitive enough to register a change of 1 millimeter in a line 1 billion millimeters—or 1,000 kilometers—long. This is impossible to achieve at the earth's surface because rainfall and temperature changes cause it to move constantly, at the level of about 1 part per million or more. So strain meters are installed about 1,000 feet down into the earth. That allows us to obtain precise measurements at the level of 1 part per billion or better.



Strain meters, which measure the deformation of rock at a single point, constitute the backbone of the Parkfield prediction experiment. Installed 1,000 feet below the surface, these instruments are sensitive enough to register a change of 1 millimeter in a line 1,000 kilometers long.

Another set of instruments measures the overall pattern of deformation in a region. At Parkfield, we use a device known as a "two-color laser geodimeter," a kind of elaborate high-tech ruler. By shooting a laser beam between hilltops up to 10 kilometers apart, we can detect changes of distance between them as small as 1 millimeter. This provides a precise measure of plate tectonics—that is, how crustal blocks move by each other on the earth's surface. A change in the pattern of slip is one possible indicator of a forthcoming quake.

In the near future, it is likely that satellites will replace instruments such as the two-color laser. An experimental global positioning satellite (GPS) system is now beginning to provide a highly accurate picture of changes in the overall surface deformation pattern of the earth. Because GPS receivers can be deployed almost anywhere on the earth's surface, rather than just on mountaintops, they will eventually provide denser and more uniform coverage.

Finally, several different arrays of seismometers detect small earthquakes in the Parkfield region. A seismometer measures infinitesimal motions of the earth's surface, and thus records the acoustic and other kinds of energy that an earthquake radiates. Data from seismometers at Parkfield are continuously sent to the USGS Western Region office in Menlo Park, where a computer analyzes the information and provides estimates of the locations and magnitudes of small quakes within three to five minutes after they occur. This warns us of possible foreshocks that might signal a forthcoming large earthquake.

In addition to these three major classes of instruments, magnetometers detect alterations in the earth's magnetic field that stress changes may cause within the crust. Creep meters measure surface slip on the fault. Fluctuations in deep-water wells are also monitored to determine possible deformation of rock near the fault. We are even experimenting with a "telluric current monitoring array" that measures changes in resistivity to electrical currents in the earth.

Data from most of these instruments travels via satellites or microwave lines to Menlo Park. There, computers monitor the data and automatically contact USGS geologists (at least two are on call 24 hours a day) when any significant changes occur. Researchers analyze the data and evaluate what has happened.

We are using so many different instruments and techniques at Parkfield because, to put it bluntly, we don't know what we're looking for. We do have some ideas

PHOTO: CARNEGIE INSTITUTE

The most successful part of the Parkfield experiment has been the prototype warning system.

about what we hope might precede a major earthquake. But they are really little more than informed guesses, and we have to cover as many bases as possible. One important thing we are learning is which instruments work best and what is a reasonable balance among instruments in a prediction effort.

Even with all these instruments, serious obstacles to obtaining accurate measurements remain. The biggest problem is that we will probably never directly sample the region where earthquakes actually occur. Most large quakes start 10 kilometers or more below the surface, so even when we bury instruments in deep holes we are just barely scratching the earth's crust. But since drilling along major fault zones is extremely difficult and expensive because the geology is so unstable, it is unlikely we will ever be able to drill any deeper than a few kilometers. Such difficulties are probably the main barrier to routine short-term earthquake prediction. They ensure that there will always be a substantial element of uncertainty.

Establishing a Warning System

Despite this uncertainty, our ability to predict earthquakes is growing. Probably the most successful part of the Parkfield experiment has been our work with state officials to create a prototype warning system that will alert residents in the area when the next Parkfield earthquake is likely.

The system defines four levels of earthquake alert. Level D, the lowest, means that some unusual seismic or slip activity has occurred, but that there is a less than 1 percent chance of a magnitude 6 earthquake within 72 hours. Since we began rating activity along the Parkfield segment in mid-1985, about 50 level D alerts have been issued.

When one array of instruments records higher levels of activity—or when many arrays of different instruments record low levels—we have a level C alert. We estimate that these have a less than 5 percent chance of leading to the next Parkfield earthquake. About 20 level C alerts have been issued in the last four years.

Stronger signals trigger a level B alert, which represents an 11 to 37 percent probability of a magnitude 6 earthquake in the next 72 hours. And a level A alert, with a probability of about 1 in 2, is for all practical purposes a prediction that an earthquake is about to occur. We have yet to issue any level B or A alerts.

When we apply these rules to what we think happened in the 1934 and 1966 Parkfield earthquakes, it appears that we could have predicted both. Under the rules we've now established, the extended foreshock sequence in 1934, three days before the earthquake, would have triggered a level A alert.

The 1966 Parkfield quake would have been more difficult to predict. Our success would have depended on what weight we gave to the cracks the Japanese seismologists discovered and to the broken irrigation pipe. However, some foreshocks four hours before the quake would have triggered a level C alert. And the foreshock 17 minutes before the main earthquake would have raised the alert to level A, although the warning would have been of little use because it probably would not have been relayed to the public in time.

When the USGS declares either a B level or A level alert, the responsibility to tell the public belongs to the state of California's Office of Emergency Services (OES). As soon as the USGS declares an alert, we contact the OES office in Sacramento, so officials can notify the counties in the Parkfield area and issue a public warning when appropriate. We estimate that people in the affected counties would know about a possible earthquake within 30 minutes after the declaration of an alert.

If we can successfully predict the next Parkfield earthquake, then the techniques developed there can be applied in urban areas of California where an early warning would do the most good. But given what we already know about the likelihood of a forthcoming earthquake that could be even more destructive than the recent Loma Prieta quake, I believe we should begin other prediction projects along the most dangerous segments of the San Andreas—even though we don't know what our chances are of producing a useful warning.

There are two obvious sites for future prediction experiments. One is along the San Andreas fault in southern California, near Los Angeles. The Coachella Valley segment studied by Kerry Sieh and his colleagues has the highest probability of a large earthquake—40 percent in the next 30 years—of any in southern California. What's more, recent seismicity along the segment—in particular, a number of moderate earthquakes at both ends—strongly resembles the pattern that has been seen prior to great earthquakes around the world.

By itself, this segment can probably produce only a magnitude 7.5 quake and may be far enough from Los Angeles not to cause major damage there. However, there is a possibility that when this segment ruptures,

Earthquake warnings, no matter how uncertain, will heighten public awareness of hazards.

so will the adjacent San Bernardino Mountain and Mojave segments to the north. When these are added to the calculation, the estimate rises to about a 60 percent chance—better than one in two—for a magnitude 7.5 or larger earthquake by the year 2020. Such an earthquake would pass within 30 to 40 kilometers of downtown Los Angeles. (By contrast, the Loma Prieta quake that damaged San Francisco and Oakland was more than 80 kilometers away.) Portions of the city might well be devastated. Clearly, there is no more important question to answer in the coming decade than how probable this worst-case scenario is.

The situation in northern California is rather different. The 70 years following the great 1906 San Francisco earthquake were remarkably quiet in the Bay Area. But since 1979, numerous earthquakes, ranging from magnitude 5 to the recent magnitude 7.1 quake at Loma Prieta, have occurred. Such activity suggests that the Bay Area may have reentered the "active phase" of the seismic cycle and that, as in the latter half of the nineteenth century, large earthquakes can be expected at a rate of one or more per decade.

This does not mean that a repeat of the great 1906 San Francisco earthquake—which hit a 400-kilometer segment of the San Andreas—is likely in the near future. Given the rate of strain accumulation on that segment, probably another 100 years must pass before such an earthquake will happen again.

However, along portions of that segment, the situation is more ominous. The southernmost 40 kilometers has already failed in the recent Loma Prieta quake. The 70 kilometers that begin at the north end of the Loma Prieta rupture and extend up the San Francisco peninsula may also be close to failure. In 1988, we estimated that there was only a 20 percent chance of a magnitude 7 earthquake on this segment in the next 30 years. But that estimate will have to be reevaluated in light of the Loma Prieta quake.

Another likely site for a major earthquake in northern California is the Hayward fault, which runs along the base of the hills that line the eastern edge of San Francisco Bay. The fault cuts directly through the major cities of Oakland and Berkeley and is almost as close to the most vulnerable portion of the San Francisco waterfront as is the San Andreas. All we know for sure about the Hayward fault is that it produced two magnitude 7 earthquakes in the last century. Minimum estimates of recurrence intervals suggest that large earthquakes could occur at any time. However, because pursuing geological or geophysical investigations in a major urban area is so difficult, our estimates about the Hayward fault are little more than guesswork. We have assigned a cumulative probability of 50 percent for a magnitude 7 earthquake on either the San Francisco peninsula or the Hayward fault during the next 30 years.

Coping with Uncertainty

Of course, even if we instrument these fault segments, earthquakes will remain extremely hard to predict. Faults are enormously complex physical systems. The record of prior earthquakes is always too short, the data incomplete, and the models imperfect. We will probably never be able to forecast earthquakes with the same accuracy with which we can forecast, say, the weather. And inevitably, there will be false alarms. Still, trying to improve our ability to predict earthquakes brings discipline to the science of seismology and is important as part of a broad effort to heighten public awareness about earthquake hazards.

Several benefits might accrue from even indefinite warnings. First, such warnings in the Los Angeles or San Francisco areas would provide an unparalleled opportunity to educate the public about earthquake hazards. Seismologists and engineers could explain on prime-time television and the front page of major newspapers why large earthquakes are inevitable along major plate boundaries, what hazards such events can pose, and what public officials and individuals can do to reduce the risk.

More important, simple steps taken in response to warnings can save some lives. For instance, hospitals can replenish emergency supplies and make sure backup power generators work and have adequate fuel. Fire stations and ambulance services can move vehicles out of buildings for a few days so they will not be trapped inside should an earthquake occur. Police and emergency-response personnel can check backup power supplies as well. They can also ensure that critical personnel have portable radios in their homes and know what their responsibilities are in case of an earthquake. Parents can talk to their children and their children's teachers about family contingency plans.

After a warning has been issued and people are aware that an earthquake may be imminent, there is also the chance that a foreshock sequence will occur. This would confirm the original forecast and give public officials

enough time to evacuate unsafe structures. For example, in 1975, a spectacular foreshock sequence preceding a magnitude 7 earthquake near Haich'eng, China, triggered an evacuation that saved as many as 50,000 to 100,000 lives.

Finally, there are the terrible costs of doing nothing. No story better illustrates that danger than the debate, early in this century, between two Japanese seismologists, Fusakichi Omori and his younger colleague Akitsune Imamura. Imamura, who had studied the historic seismicity of Japan, believed that it had been a very long time since the region south of Tokyo had experienced the kind of large earthquake common along the Japanese archipelago. Therefore, he reasoned, a major quake was probably imminent. In making this prediction, Imamura seems to have intuited some form of what we now call "seismic gap" theory—the idea that the most likely place for an earthquake along a fault is where there has been a gap in seismicity. Imamura also pointed out that fire-fighting facilities in Tokyo were inadequate and that as many as 100,000 people might die in the fire likely to follow a large quake.



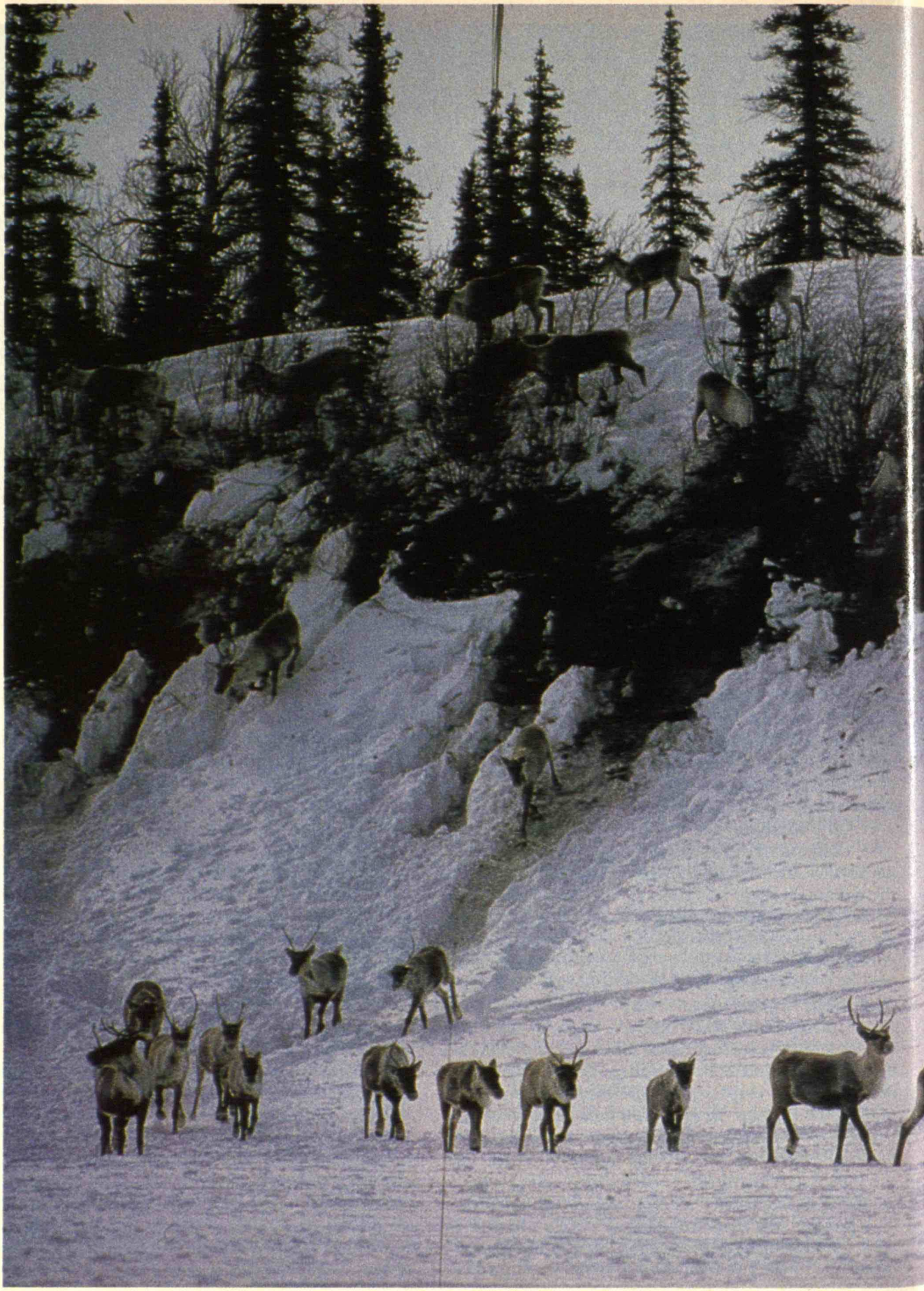
Someday, the techniques developed at Parkfield will help monitor fault segments near the urban areas of California, where an earthquake warning system would do the most good.

Omori, who was one of the great early seismologists, strongly disagreed, on the grounds that Imamura's arguments were both scientifically unjustified and socially irresponsible. And since Omori was the senior colleague, his view prevailed.

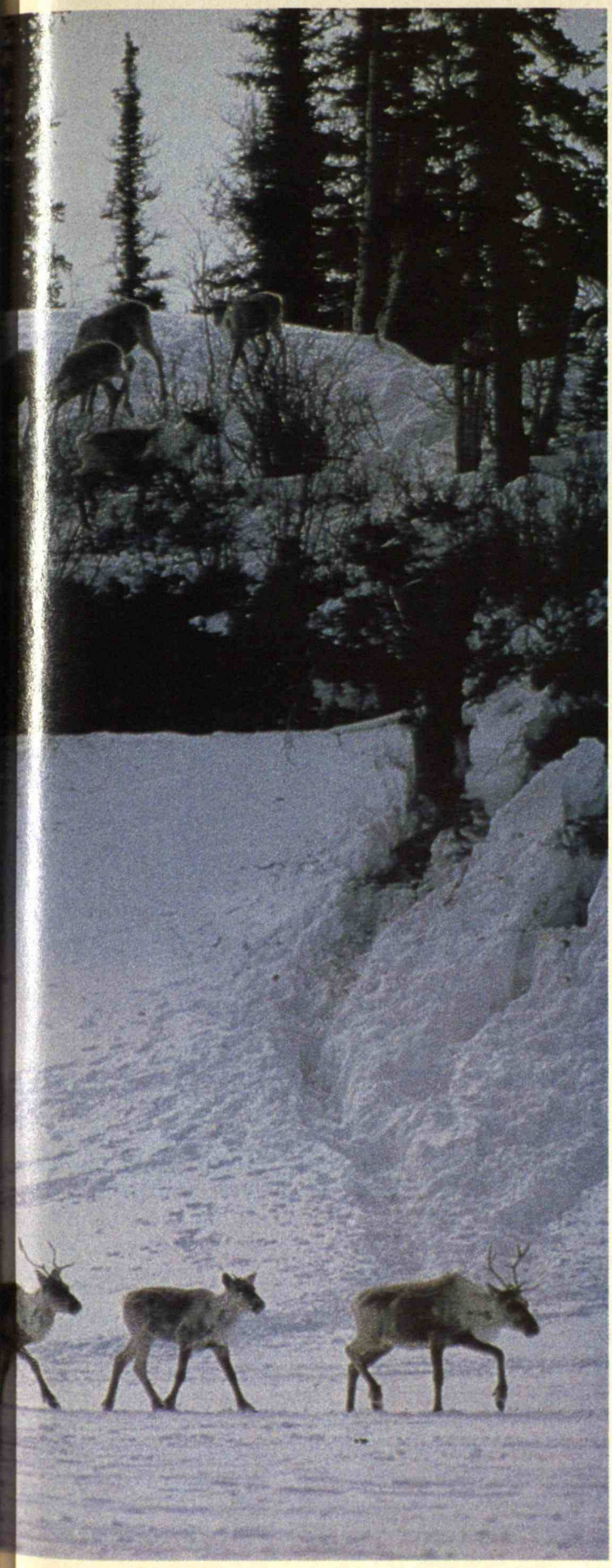
On September 1, 1923, Omori was visiting a seismic observatory in Sydney, Australia, when the waves from the great Tokyo earthquake, in which 140,000 people died, began to roll in. He quickly realized that his younger colleague had been correct. Omori took ill on his return voyage to Japan and died soon afterward, but not before he called Imamura to his deathbed to apologize and take responsibility for the tragedy.

Despite the progress of the last 60 years, our situation is still much like that of Imamura and Omori. We are forced to make decisions in the face of great uncertainty. But given the enormous damage and loss of life a large earthquake near urban areas could cause, we cannot sit on our hands and plead ignorance. The question is how to communicate to society what we do understand in a way that is useful. ■

PHOTOS: SCOTT ANGER, ERIC SANDER/BOTH GAMMA LIAISON



PHOTOS: GEORGE W. CALEF/CANADIAN ARCTIC RESOURCES COMMITTEE; INDIAN AND NORTHERN AFFAIRS CANADA



Global Commons

The Arctic in World Affairs



As the global role of the North Polar region grows, Arctic nations are finding reasons—and ways—to cooperate.

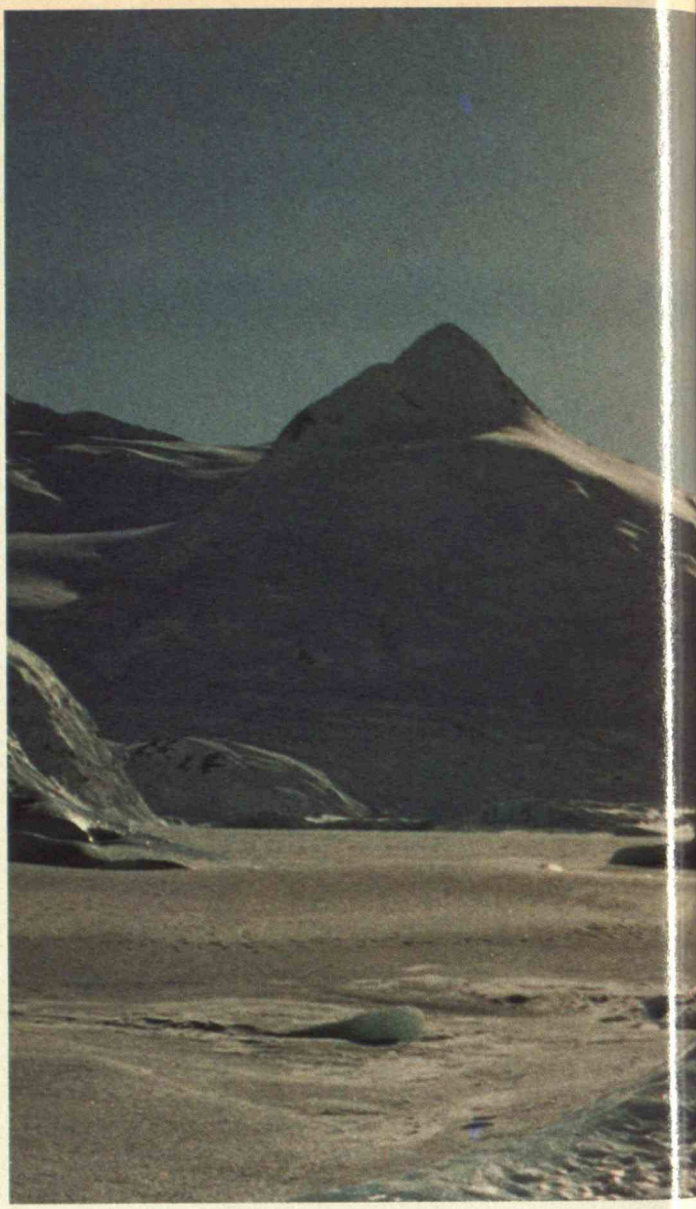
By Oran R. Young

LONG dismissed as a frozen wasteland, of interest only to a handful of explorers, traders, missionaries, scientists, and indigenous people, the Arctic has emerged as a region of major significance. As the possibilities for military, economic, and environmental benefits and losses rise, so, too, do the stakes of all the Arctic nations in devising ways to work together. It would be pointless and wasteful if people in different parts of the Arctic attempted to solve the same problems again and again.

All Arctic states can gain from cooperating to devise ways of exploiting Northern resources while protecting the region's ecosystems and cultures. The Soviets, for example, could teach the West much about constructing multi-storied buildings on permafrost, about Arctic marine transportation, and about providing a measure of self-government to Northern peoples. Canada and the United States could share their experience in building small dwellings for Northern conditions, using specialized transportation such as snowmobiles and all-terrain vehicles, and designing and implementing environmental safeguards. Scandinavian countries, which have the most effective systems of reindeer husbandry, could further Soviet practices in this field. And capitalist and socialist nations alike want to reduce the high cost of extracting Arctic raw materials and transporting them to distant markets.

Fortunately, policymakers are grasping—albeit slowly—the potential for regional collaboration. While the most recent formal expression of U.S. Arctic policy, a 1983 National Security Defense Directive, declares that the United States has "unique and critical interests in the Arctic region," it also speaks explicitly of "promoting mutually beneficial international cooperation in the Arctic." Joe Clark, Canada's secretary of state for external affairs, calls regional cooperation a "trend of enormous importance," stating that Canada "wishes to see peaceful cooperation among Arctic Rim countries developed further."

The clearest and strongest exhortations come from the Soviet Union. In a major speech in Murmansk in 1987, Mikhail Gorbachev laid out a program for cooperation and pledged the Soviets' "profound and certain interest in preventing the North of the planet, its Polar and sub-Polar regions, and all Northern countries from ever again becoming an arena of war." In the ensuing years, the Soviets have vigorously pursued an initiative to roll back the militarization of the Arctic by declaring it a "zone of peace."

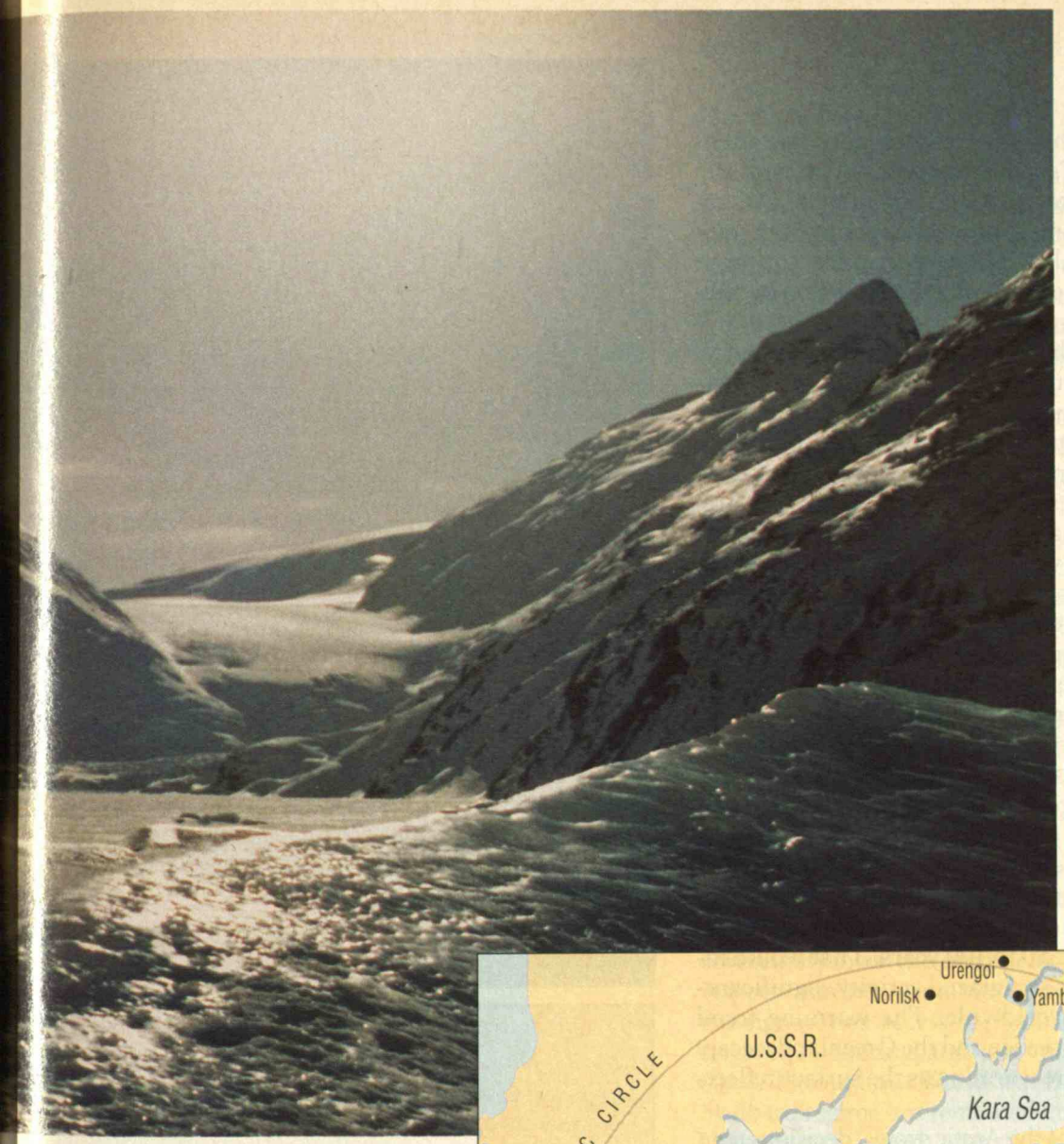


For a region where international cooperation was until recently considered either unnecessary or—because the superpowers were directly involved—infeasible, this growing sentiment signals a welcome change. It is transforming the region, even as it stimulates an awareness of the need to maintain the integrity of the Arctic.

Global Stakes

The spirit of cooperation has grown as the Arctic Rim states have increased their activities in the Far North. While military analysts in the 1960s and 1970s considered the Arctic a remote periphery over which missiles might fly, the relatively empty spaces are now convenient locales for operating both nuclear submarines and bombers equipped with long-range cruise missiles. Accordingly, the Pentagon is pursuing Arctic air and sea defenses such as the North Warning System, being built by the United States and Canada, and the U.S. Na-

ORAN R. YOUNG directs the Institute of Arctic Studies at Dartmouth College and cochairs the Working Group on Arctic International Relations. He is co-author of The Age of the Arctic: Hot Conflicts and Cold Realities *(Cambridge University Press, 1989) and author of* International Cooperation Building Regimes for Natural Resources and the Environment *(Cornell University Press, 1989.) He is a member of the National Research Council's Polar Research Board and an advisor to the U.S. Arctic Research Commission.*



Several nations, including the two superpowers, border the Arctic or claim territory in the region, and have been stepping up their activities there. As a result, both the potential and the need for regional collaboration are growing.

vy's planned SSN-21 attack submarine.

The Arctic has also gained prominence as a secure source of raw materials. Alaska's North Slope is North America's largest oil-producing area, and the U.S. Northeast is coming to rely on electricity from massive hydroelectric plants in northern Quebec. Fossil fuels off Norway's north coast seem destined to help limit Western Europe's dependence on Soviet natural gas, while the region looms even larger in Soviet plans. Giant Siberian gas fields at Urengoi and Yamburg dominate efforts to expand fossil-fuel production, and the Soviets have become leaders in industrial hydropower by harnessing Siberian rivers.



PHOTO: LAURA REED; MAP: DEBORAH PERUGI DESIGN

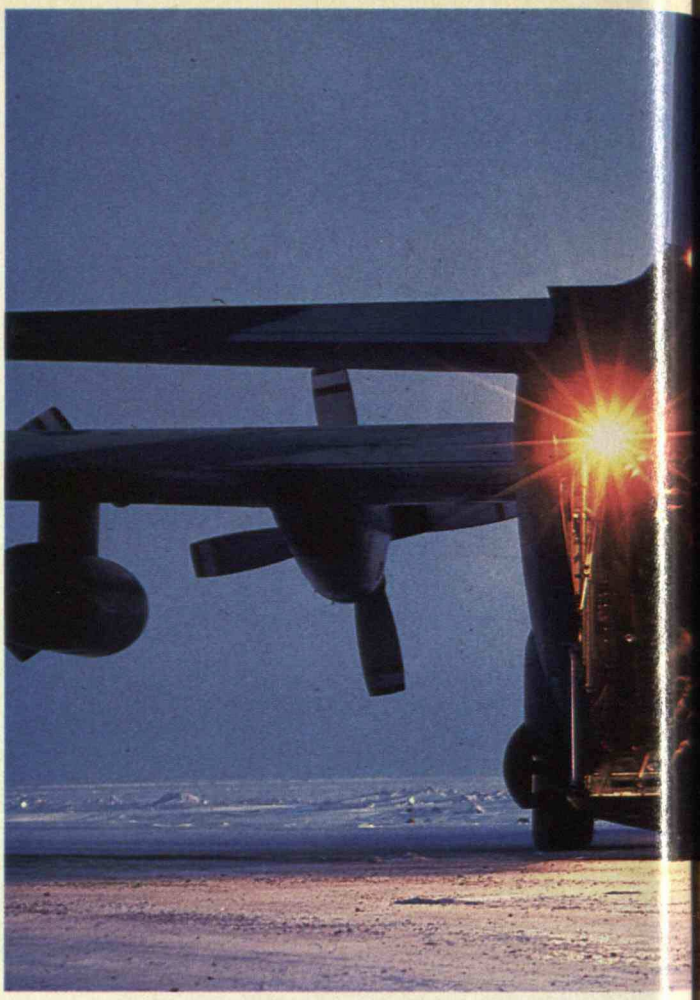
With the growing human presence has come attention to the region's environment. Atmospheric phenomena peculiar to the Arctic can interfere with radar and other communications, endangering both military and commercial aviation. Arctic ice can pose obstacles to submarines or hinder the operation of drilling rigs on continental shelves.

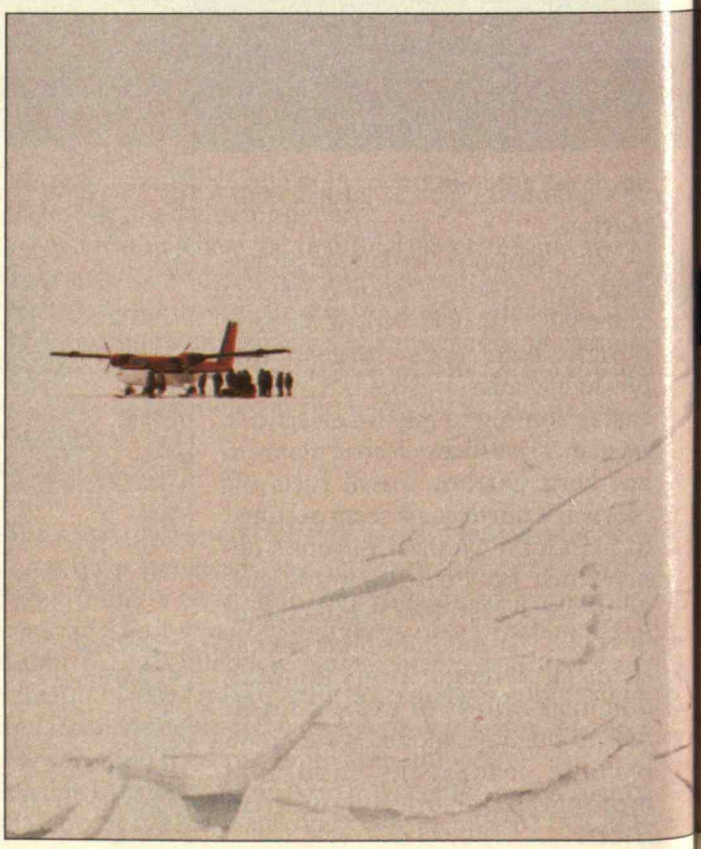
Dramatic evidence has surfaced of links between Arctic phenomena and human activities elsewhere. Interactions among Arctic sea, ice, and air are major determinants of weather throughout the Northern Hemisphere. Heavy metals and other toxic substances originating far to the south show up regularly in Arctic fish and marine mammals and subsequently in the breast milk of native women. Wind blows carbon dioxide, sulphates, soot, sulphur dioxide, chlorofluorocarbons, and even radioactive materials toward the Far North. Owing to the prevailing water and air currents, these pollutants accumulate in the Arctic atmosphere, and the region is plagued each winter and spring by a dense blanket of haze that can reduce visibility more than the smog of Los Angeles.

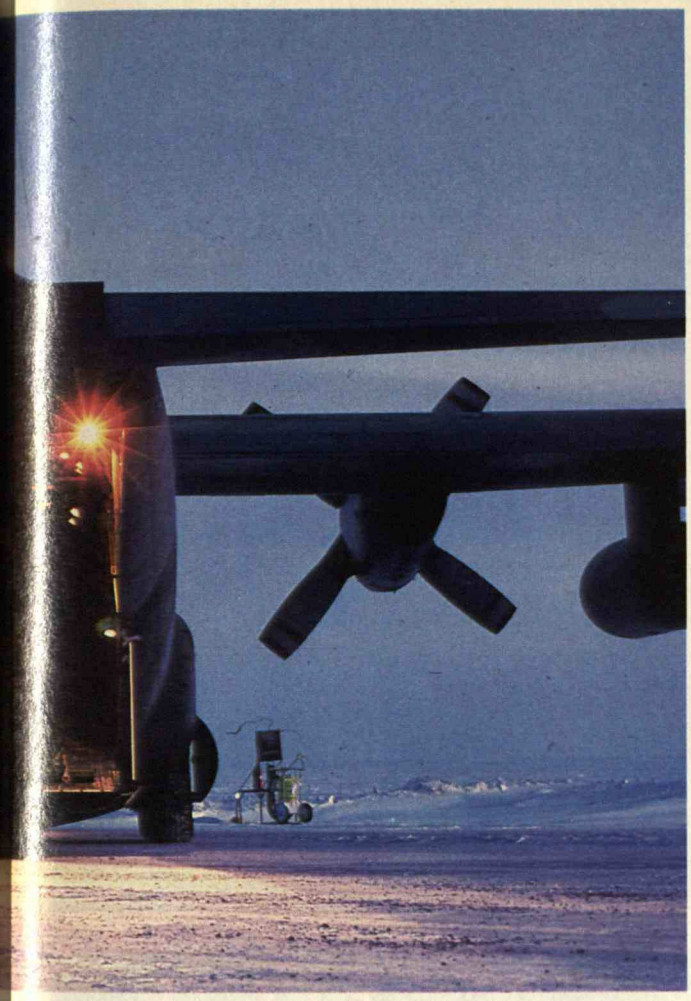
Arctic air masses are also particularly effective traps for greenhouse gases, including carbon dioxide. There is consensus within the scientific community on projections that global warming will raise temperatures two to three times as much in the Arctic as in the mid-latitudes over the next 50 to 100 years. That would increase Arctic snowfall and glacial activity, significantly raising sea levels worldwide. The warming trend could also melt Arctic sea ice and the Greenland icecap. That would mean more warming as the surface reflects less sun.

As the significance of the Arctic grows, decisions tend to be made by outsiders who are seldom well informed about, or sensitive to, the concerns of the Arctic's 10 million inhabitants. Because what is happening to the region presents a growing threat to these peoples, especially those anxious to protect their distinctive ways of life, they are expressing their legitimate interests in all the military, economic, and environmental issues. They have sought to be heard not only by intervening in state, provincial, and federal arenas, but also by organizing themselves across national borders.

At the same time, the international community of scientists working on Arctic issues is growing and is becoming more politically active. In the United States, the Arctic Research and Policy Act of 1984 has given a powerful shot in the arm to scientific endeavors. Moreover, it is expected that representatives of all nations with major Arctic interests will formally establish the International Arctic Science Committee (IASC) this year. This body will give scientists an effective voice in international circles and a forum for discussing and coordinating research.









The empty spaces of the Arctic have become a major theater for miltary operations. Above, a U.S. C-130 transport readies for takeoff. At left, the nuclear-powered submarine USS Sturgeon *keeps an Arctic rendezvous with a DeHaviland Otter.*

Precedents for Cooperation

As the Arctic Rim nations step up their joint activities, they can build on a substantial body of Arctic international cooperation that already exists. This ranges from scientific and technical collaboration to agreements on the environment and on military security.

On the one hand, the record includes relatively modest bilateral arrangements. For example, an agreement between Norway and the Soviet Union governs the exploitation of marine resources in a disputed area of the Barents Sea. And the Marine Environmental Cooperation Agreement between Canada and Denmark protects the ecosystems of Baffin Bay and the Davis Strait.

On the other hand, several Arctic agreements are far-reaching and multilateral. Three merit particular attention: an agreement about rights to the Svalbard Archipelago, an accord to conserve polar bears, and a pact that seeks to protect northern fur seals.

The Svalbard Archipelago, 600 miles northwest of Norway, is about the size of Belgium and the Netherlands combined. Once a bone of contention among Great Britain, Norway, Russia, and Sweden, the archipelago's status was settled in the Treaty Relating to Spitsbergen, which went into force in 1925. Now encompassing the United States, the Soviet Union, and 38 other nations, this agreement recognizes Norwegian sovereignty over the archipelago. In return, Norway respects previously established rights in the area, allows the signatories access to Svalbard's natural resources on an equal footing, and keeps the archipelago demilitarized. Throughout World War II and the Cold War, the Svalbard regime has remained intact, proving that state sovereignty need not foreclose international cooperation.

The polar bear, a quintessential symbol of the Arctic, has long been a target of trophy hunters from affluent societies. By the 1960s, growing concern about the status of polar-bear stocks led to a remarkable set of scientific initiatives, culminating in a 1973 agreement among Canada, Denmark, Norway, the Soviet Union, and the United States to protect the species. This success shows that the two superpowers and lesser nations can cooperate. It also offers a distinct model for collaboration, since the scientific community—rather than politicians—provided the leadership for both its creation and its implementation.

The stock of northern fur seal, an animal prized for its skin, was severely depleted toward the end of the nineteenth century by open-sea harvesting. Unilateral U.S. efforts to regulate the harvest created sharp conflict with Great Britain. But in 1911, after the decline had reached crisis proportions, Great Britain (acting for Canada), Japan, Russia, and the United States agreed to protect the North Pacific fur seal. This treaty

PHOTOS: DOD; HAROLD J. GERWIEN, U.S. NAVY



banned sealing in the open sea and placed all harvesting operations on the islands of the eastern Bering Sea under U.S. control and those in the western Bering Sea under Russian control.

Widely credited with halting the depletion of fur seal and even allowing its numbers to grow, this pioneering arrangement worked for decades. Unfortunately, the population is declining again, amidst controversy over the reasons why. In 1984, the U.S. Senate failed to extend participation in the treaty, in part because animal protectionists opposed an agreement that would allow *any* killing of wild animals.

The Rising Tide

Despite that setback, recent years have been marked by an unusual ferment of joint activities in the Arctic. Among several bilateral initiatives, Canada and the United States signed an Agreement on Arctic Cooperation in 1988. The United States has pledged to obtain Canadian consent for U.S. icebreakers to navigate in areas claimed as internal waters by Canada, even though the nations have agreed to disagree on the legal status of the waters of the Arctic Archipelago. Since then, the *Polar Star* has crossed the Northwest Passage from west to east without provoking even a ripple of the angry Canadian response that followed the 1985 east-to-west transit of its sister ship, the *Polar Sea.*





An international agreement signed in 1973 protects polar bears. But a half-century-old treaty to protect northern fur seals hasn't been renewed, and their numbers are declining. The interest of many nations in the Arctic also threatens its indigenous cultures. At left, in Canada's Northwest Territories Ellen Bruce smoke-tans a caribou hide on a frame of willows.

PHOTOS: FRED BRUEMMER/PETER ARNOLD INC.; INDIAN AND NORTHERN AFFAIRS CANADA; GEORGE W. CALEF/ CANADIAN ARCTIC RESOURCES COMMITTEE







In Canada, language studies (top) can continue alongside traditional tasks while Inuit men hunt in snowmobiles (left). Indigenous organizations such as the Inuit Circumpolar Conference (above), shown meeting in Greenland in 1989, are taking the lead in attempts to define the place of the Arctic in international affairs.

The Soviet Union has signed bilateral agreements with Norway, Sweden, and Finland. One agreement with Norway provides a framework for environmental cooperation. It includes agreed measures for cleaning up oil spills in the Barents Sea and on resolving conflicts over air and water pollution emanating from the Kola Peninsula. The Soviets have also agreed to notify Norway about nuclear accidents that could produce radioactive contaminants. This agreement, as well as a similar one between the Soviet Union and Sweden, stemmed from concerns about a Soviet nuclear power plant on the Kola Peninsula.

Soviet bilateral ventures with the United States and Canada are also expanding. An agreement setting forth a U.S.-Soviet oil-spill contingency plan for the Bering Sea and its northern neighbor, the Chukchi Sea, was signed in May 1989. And a framework agreement with Canada on Arctic cooperation, widely discussed since 1987, was finalized during Prime Minister Brian Mulroney's visit to the Soviet Union in November 1989.

Among the smaller states, Denmark and Norway appear to be settling a long-standing dispute over maritime boundaries between Greenland and the island of Jan Mayen. In August 1988, Denmark submitted the case to the International Court of Justice, and Norway has accepted the jurisdiction of the court over the case.

Even more encouraging than bilateral initiatives is the growing recognition that many Arctic problems re-

PHOTOS: CULTURAL SURVIVAL; ALOOTOOK IPELLIE/INUIT CIRCUMPOLAR CONFERENCE



The Arctic is a prominent source of raw materials for both East and West. Giant Siberian gas fields dominate Soviet efforts to expand fossil-fuel production. These pipes, built in the 1970s, supply gas to the central and western Soviet Union.

quire multilateral responses. The Soviet Union's zone-of-peace initiative has done much to nourish interest in a comprehensive international regime in contrast to a collection of issue-specific agreements. In his 1987 speech, Gorbachev called for a network of arrangements, such as nuclear-weapons-free zones, restricted naval activities, cooperative resource development, coordinated scientific research, environmental cooperation, and opening the Northern Sea Route to foreign ships. He acknowledged as well the interests of the indigenous population of the North.

The establishment of an International Arctic Science Committee to foster research is particularly significant. Despite impressive achievements during the International Polar Years of 1882-83 and 1932-33, the Arctic has lacked an international scientific community of the sort that has played a prominent role in the Antarctic. Starting with a meeting in the United States in 1986, the IASC negotiations are nearing agreement on a charter or set of founding articles for the committee. All parties have made concessions. In particular, the Soviets no longer insist on restricting participation to the five states bordering the Arctic Ocean.

This abundance of governmental actions has given rise to a flurry of private initiatives. Many of these efforts are bilateral, like one on medical research between the University of Alaska and the Siberian Branch of the Soviet Academy of Sciences. But a growing number call for cooperation from several or all Arctic states.

A striking example is the Inuit Regional Conservation Strategy, which is being developed under the auspices of the Inuit Circumpolar Conference (ICC), a nongovernmental organization representing native people in Greenland, Canada, the United States, and the Soviet Union. This innovative effort to apply the principles of the World Conservation Strategy in a regional setting has won strong support from the United Nations Environment Programme and has become a significant force in promoting international cooperation on Arctic environmental issues.

In fact, the Arctic's indigenous peoples—Inuit, Indians, Saami, Komi, and Yakuti, among others—have taken the lead in promoting international cooperation and awareness of the Arctic as a distinctive international region. The main transnational Arctic organizations—such as the ICC, Indigenous Survival International, and the Nordic Saami Council—are all products of initiatives taken by indigenous peoples.

The Road Ahead

While the opportunities for cooperation have grown steadily, there remains, as Soviet Prime Minister Nikolai Ryzhkov has put it, a "lack of trust that has built up in a region so sensitive from the viewpoint of security interests." Most important, the strategic or military perspective on the Arctic conflicts with cultural, scientific, and environmental viewpoints. Military planners see the Arctic as a theater of operations for weapons and, potentially, for combat. That idea is antithetical to collaborative research and efforts to protect shared ecosystems. And it is regarded with horror by the permanent residents of the Arctic, for whom the region is a homeland, not a battleground for alien powers.

Cooperative efforts suffer as well because no state has a clear-cut decision-making process for Arctic matters, much less a coherent policy. While most Arctic states have made valiant attempts at interagency coordination, none has produced unambiguous success. Canada had an Advisory Committee on Northern De-

velopment for some years, but it is now defunct. The U.S. Interagency Arctic Policy Group within the National Security Council has struggled to coordinate 12 to 15 independent agencies, but without much to show for its efforts. It is too early to tell if the Soviet Union's high-level State Commission for Arctic Affairs, created in 1988, will affect entrenched bureaucracies.

A number of generic problems, such as the choice of signatories to any agreement or the impact of positional bargaining tactics, further complicate efforts to realize joint gains. For example, the Soviets wanted the IASC to be inaugurated in their territory, where it would have advanced the zone-of-peace initiative. But the United States blocked that move. As a result, the committee will probably be founded in Canada.

Still, such problems can be solved or swept aside when the will to act is strong. No doubt the Soviets are keen to make progress, but there is room for skepticism about U.S. intentions. The unmistakable enthusiasm of American scientists is not matched by unambiguous support from senior politicians.

Another obstacle is a lack of leadership. Neither the United States nor the Soviet Union dominates Arctic politics, since efforts by one power provoke skepticism, if not outright opposition, from the other. The United States and the Soviet Union could exert effective pressure together, but Washington has given a low priority to Arctic matters.

This leaves the smaller Arctic states, perhaps led by Canada, best suited to take the central role. In many ways, such a role appeals to these states. Canada, in particular, may find it attractive. Not only would it fit many Canadians' image of their place in global society, but it would also alleviate some of their fears of being sandwiched between the superpowers.

Admittedly, the recent efforts of the lesser Arctic states have not been particularly well conceived or effective, and whether these nations can pull together to offer leadership is open to question. Although the Finns are vigorously promoting multilateral environmental arrangements, the other nations had trouble taking the initiative in the complex IASC talks. For example, the talks revealed a division between Canadians who hoped to promote their nation's political agenda regarding Arctic sovereignty and those who wanted to separate scientific goals from the rest of the agenda.

While these obstacles cannot be ignored, they do not alter the fact that the Arctic is coming into its own as a focus of attention among policymakers in all the Arctic Rim states. The rising tide of human activities in this environmentally sensitive region demands an increased effort to coordinate actions not only to reap mutual benefits but also to avoid mutual losses. The result is a growing challenge requiring both innovative political thinking and effective leadership. Under the circumstances, the Arctic seems destined during the 1990s to become a proving ground for new approaches to international cooperation. ■



Poles Apart

WITH the experience of Antarctica in mind, outside powers often approach the Arctic with explicit, multilateral, and comprehensive arrangements in mind. But the two poles are antipodes in more than geography.

Even in an era of creeping claims over "global commons," the sovereignty of states reaches farther into the Arctic than it does into the oceans, the atmosphere, or Antarctica. No one questions the authority of Canada, Denmark (Greenland is a part of Denmark), Norway, the Soviet Union, or the United States over their Arctic sectors, even if ice masks the boundary between land and sea. By contrast, when the Antarctic Treaty was signed in 1959, no nation advancing a territorial claim in Antarctica could have met even the most lenient standard of effective occupancy.

Nor has Antarctica been a major military arena. Demilitarization under the 1959 treaty simply recognized a prevailing situation. Contrast this with the strategic significance of the Arctic to both superpowers. Whatever the prospects for cooperation on other matters, demilitarization appears distant.

Another difference is that no commercial ventures were taking place in Antarctica in 1959, except for some whaling operations that the treaty ignored. Nor are such activities expected to take on major proportions, a fact that facilitated the negotiations leading to the 1988 Convention on the Regulation of Antarctic Mineral Resource Activities. The contrast with Arctic oil production and other world-class industrial operations couldn't be sharper.

Moreover, because the South Polar region has no permanent residents, diplomats and scientists have been able to devise cooperative arrangements without considering local reactions. But the native peoples of the North rightfully demand a voice in developing Arctic policies.

Finally, the Antarctic treaty grew out of the interests of a global scientific community. It was formalized in the aftermath of the International Geophysical Year, and the International Council of Scientific Unions has fought to keep the continent dedicated to science. Despite potentially important developments within a small Arctic scientific community, there is no comparison between the regions in these terms.

Thus, simplistic analogies merely confuse the prospects for Arctic cooperation. The issues requiring coordination in the Arctic are in many ways more serious than those that spurred agreements in Antarctica. This does not rule out international cooperation in the Arctic, but because the stakes are higher, parties are apt to have a harder time reaching agreement on the provisions of any Arctic agreement. ■

—Oran R. Young

PHOTOS: TASS/SOVFOTO; KEITH-NELS SWENSON/GREENPEACE

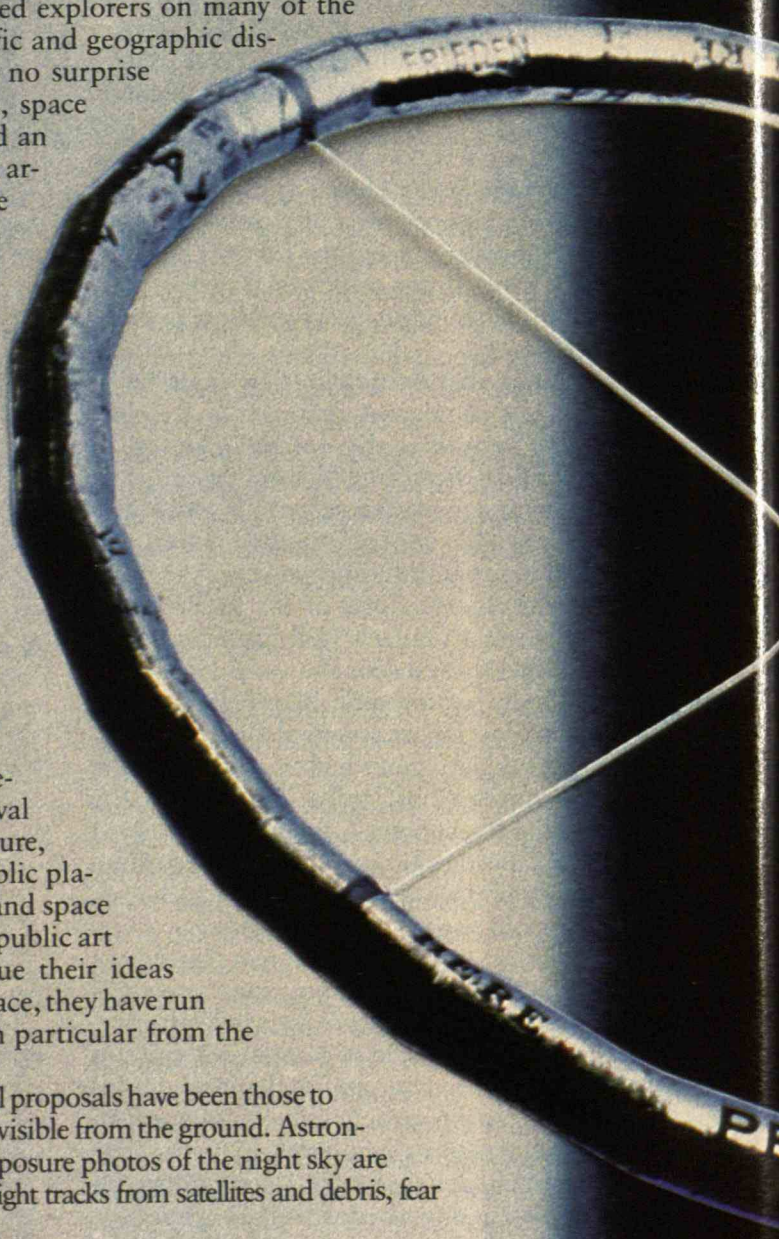
As artists strive to turn outer space into a new canvas for creative expression, some of their proposals have provoked controversy.

Art in Space

Artists have accompanied explorers on many of the great voyages of scientific and geographic discovery. So it should be no surprise that, in the last decade, space exploration has inspired an extraordinary variety of artistic activities. Artists are creating giant works of art on earth intended to be viewed from space, sending art on board the space shuttle, and developing detailed proposals for lofting into orbit sculptures that would be visible from the ground.

Predictably, the very idea of space art has sparked enormous controversy. "Public art" has become the object of heated debate (witness the removal of Richard Serra's sculpture, *Tilted Arch,* from a public plaza in New York City), and space art is perhaps the most public art of all. As artists pursue their ideas for creating works in space, they have run into stiff opposition, in particular from the scientific community.

The most controversial proposals have been those to create orbiting artworks visible from the ground. Astronomers, whose time exposure photos of the night sky are already contaminated by light tracks from satellites and debris, fear



The OURS Space Peace Sculpture is one of many works that artists have proposed to put into orbit. An inflatable ring, 20 to 30 feet in diameter, it is scheduled for launching from the *Mir* space station in 1992, the International Space Year.

BY ROGER F. MALINA

PHOTOS: OURS PROJECT



that space sculptures will contribute to light pollution. Space engineers also worry about unnecessary debris with which spacecraft could collide. And some ecologists object to orbiting art that would brighten the night sky and perhaps disturb the biological rhythms of nocturnal animals.

Space artists counter that all orbiting satellites contribute to light pollution and space debris. They argue that the same rules should apply to space art as to scientific, military, and commercial satellites.

As both an astronomer and an editor of a journal about technology and the arts, I think space art is a legitimate and desirable activity. Scientists who dismiss artists' proposals as frivolous forget that one of the roles of artists has always been to create markers of human presence. Space art is an essential part of extending human civilization into the cosmos.

Space art might also rekindle public support for further space exploration. Many people remember the powerful impact of watching the first satellites as they made their way, visible as small points of light, across the night sky. Such experiences helped build public support for the early space program. Orbiting sculptures or other space art might have a similar effect.

Nevertheless, the critics have some valid concerns. Some proposals for orbiting sculptures do pose an unnecessary threat to astronomical observation. What's more, the heavens are a uniquely vulnerable canvas. As



the cost of major space-art projects comes within the range of corporate advertising budgets, space art runs the risk of becoming commercialized. Therefore, it is urgent that scientists, artists, and the public work together to develop ground rules for what is acceptable art in the sky.

Symbols of Human Culture

The most common category of space art is not located in space at all. Rather, it consists of works constructed on earth that are meant to be viewed from space. Ever since astronauts photographed the earth from the *Apollo* capsules as they journeyed to the moon, the image of the fragile blue-green globe floating in space has been a symbol of humanity's interdependence. Artists have responded to this powerful image by making visible the human presence on the planet and projecting outwards symbols of human culture.

In 1980, artist Tom Van Sant built a large reflecting pattern in the shape of a human eye, a mile and a half across, on the desert floor of the Shadow Mountains in California. The work, entitled *Reflections from Earth,* is visible on photographs taken by the *Landsat* satellite. In 1986, Van Sant created an even more ambitious piece called *Desert Sun.* Forty-eight mirrors, each four feet square, reflected sunlight to the *GEOS-6* satellite passing overhead. The satellite then transmitted pictures of the earth, in which the reflected image was visible, to viewers in Los Altos, Calif.

French artist Pierre Comte carried out a similar project in the fall of 1989. In the south of France, Comte used sheets of white plastic, about 200 feet square, to create a huge version of the astronomical sign for the planet Earth. The work has been photographed by the *SPOT* remote-sensing satellite, and will continue to serve as a calibration marker for testing remote-sensing satellites that view southern France.

Space Art or Light Pollution?

Such works have been relatively uncontroversial. The kind of space art that has attracted the most attention from both artists and scientists involves actually placing works of art in orbit. The space shuttle's Getaway Special program, established in the early 1980s for carrying small experiments at a low price, elicited many fascinating proposals for sending art into space. Joe Davis, a research fellow at MIT's Center for Advanced Visual Studies, proposed a work called *New Ruby Falls* that would use a pulsed electron gun to create artificial auroras visible from the ground during a shuttle flight. Artist Joseph McShane conceived of a work in which an orbiting satellite would use a radio signal to activate sculptures at satellite groundstations around the world as it passed overhead.

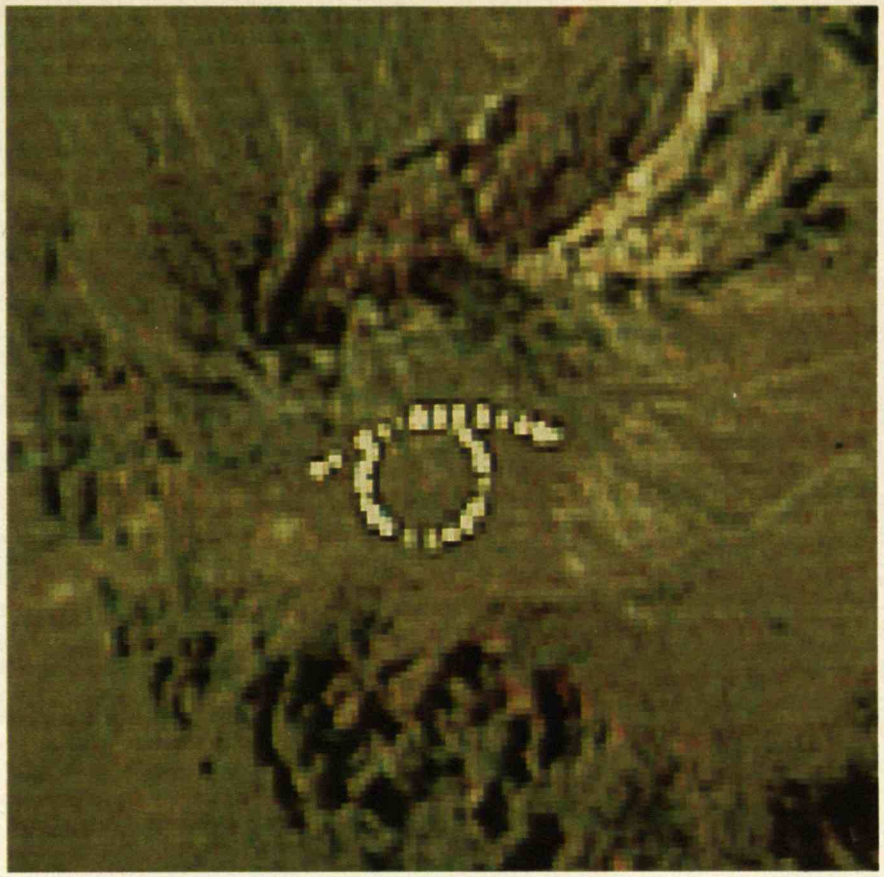
The *Challenger* accident has meant that few of the ideas for art on the space shuttle have been realized. Those that have gone into orbit on the shuttle have been largely conceptual, self-contained in canisters, and not visible from the ground.

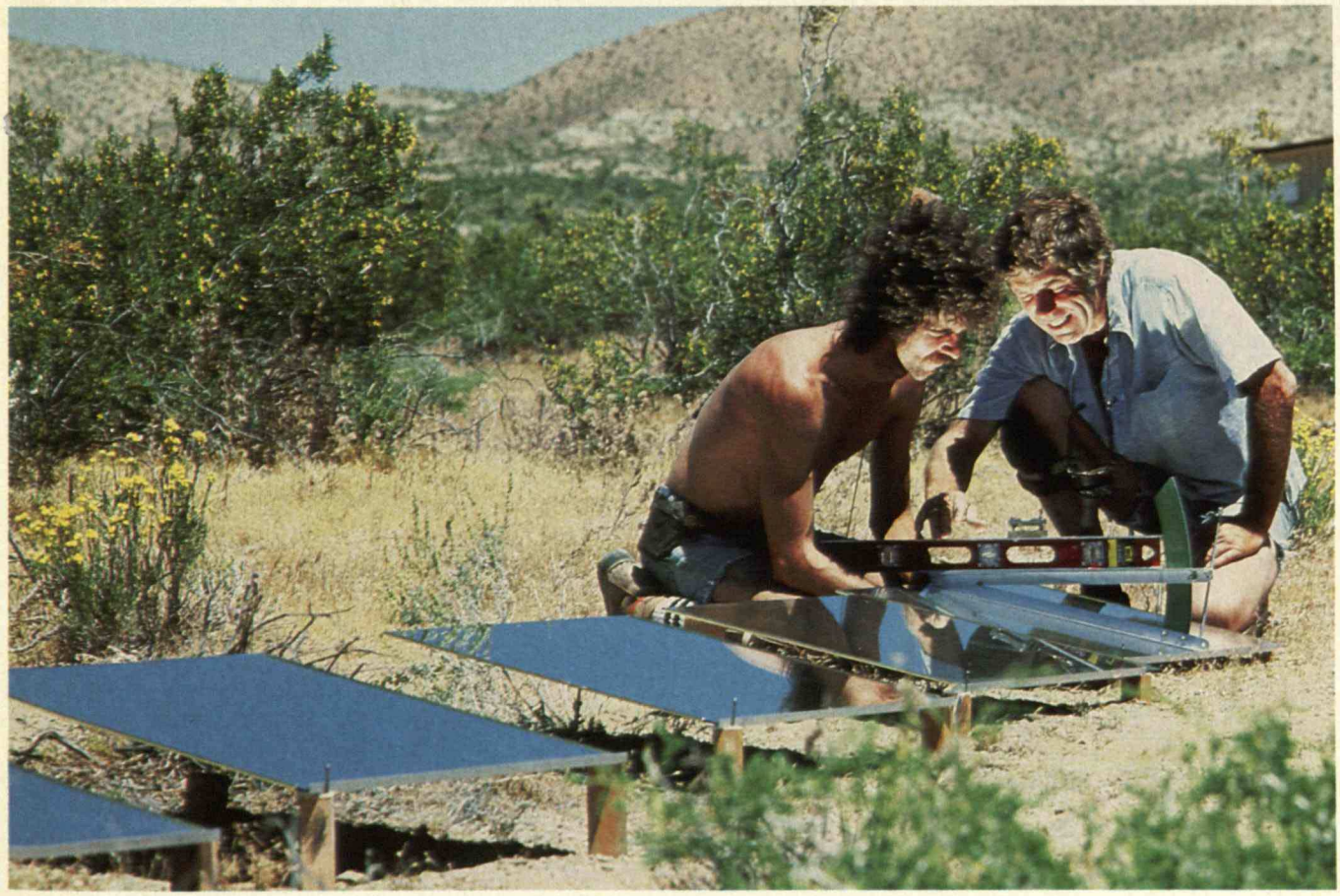
Yet problems with the U.S. space shuttle have not dimmed artists' in-

Astronomer ROGER F. MALINA is executive director of the Center for Extreme Ultraviolet Astrophysics at the University of California, Berkeley. He is also executive editor of Leonardo, *the journal of the International Society for the Arts, Sciences, and Technology, and co-chairman of the Subcommittee on the Arts and Literature of the International Academy of Astronautics.*

PHOTOS: NASA/LANDSAT/OTTO PIENE

The familiar image of Earth as seen from space (left) has become a symbol of humanity's interdependence. Artists have responded to this image by creating art that projects the human presence into the cosmos. For example, Tom Van Sant (below, wearing shirt) has placed mirrors in the shape of an eye, a mile and a half across, on the desert floor of the Shadow Mountains in California. The sculpture is visible in a *Landsat* photograph (right).







Proposed space sculptures will use a range of traditional and new technologies. The tethered reflecting balloons (right) to be launched in conjunction with this year's International Goodwill Games in Seattle are similar to the *Echo* satellites of the early 1960s. The orbiting rings of the OURS Project (left) will be made from a new kind of fabric impregnated with a resin that hardens in sunlight. This allows the sculptures to be stored in a compact shape, then inflated and made rigid in space. One OURS sculpture, planned for the year 2000, will be about a kilometer in diameter. It will be visible as a circle or ellipse in the sky (inset right) for about 10 minutes before sunrise and after sunset.

terest in orbiting art. In 1986, the Eiffel Corp.—owner of the foremost nineteenth-century example of public art— sponsored a competition for orbiting space sculptures. The contest attracted 99 entries and a great deal of media attention throughout Europe. The winning project, submitted by Alain Coquet and a supporting team, proposed placing in permanent orbit 100 balloons tethered together in a circle 15 miles around. The sculpture would have looked like an artificial constellation in the sky.

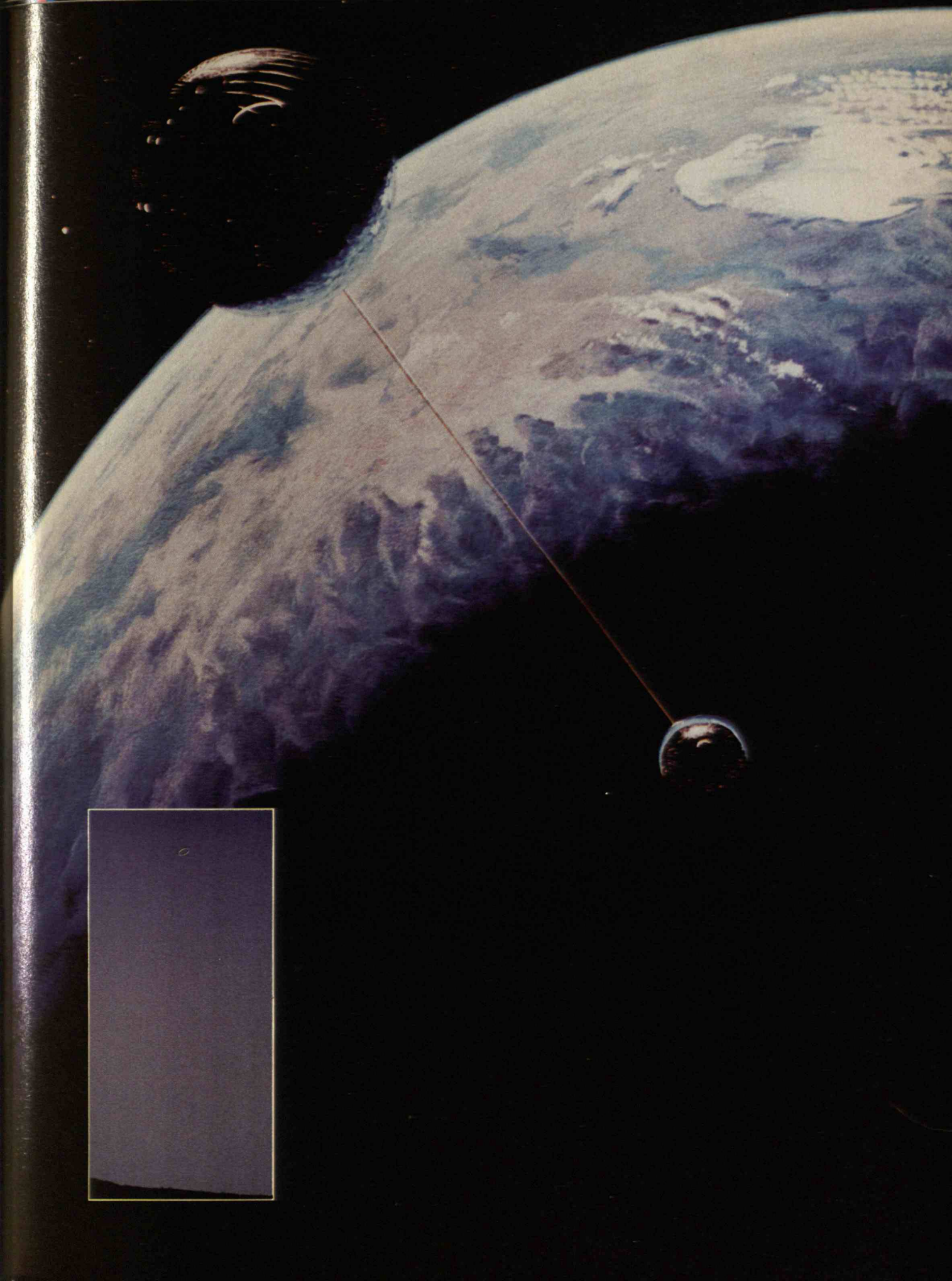
Coquet's project would have obstructed the view of astronomers, and scientists were able to persuade the European Space Agency to block it. Since then, the International Astronomical Union, the International Academy of Astronautics, and the American Astronomical Society have all passed resolutions to stop orbiting space sculptures. "Space art is another threat to dark and radio quiet skies," states a recent newsletter of the International Dark Sky Association, an organization of astronomers dedicated to protecting observatories from light pollution. "What is art to one person may be junk or pollution to another."

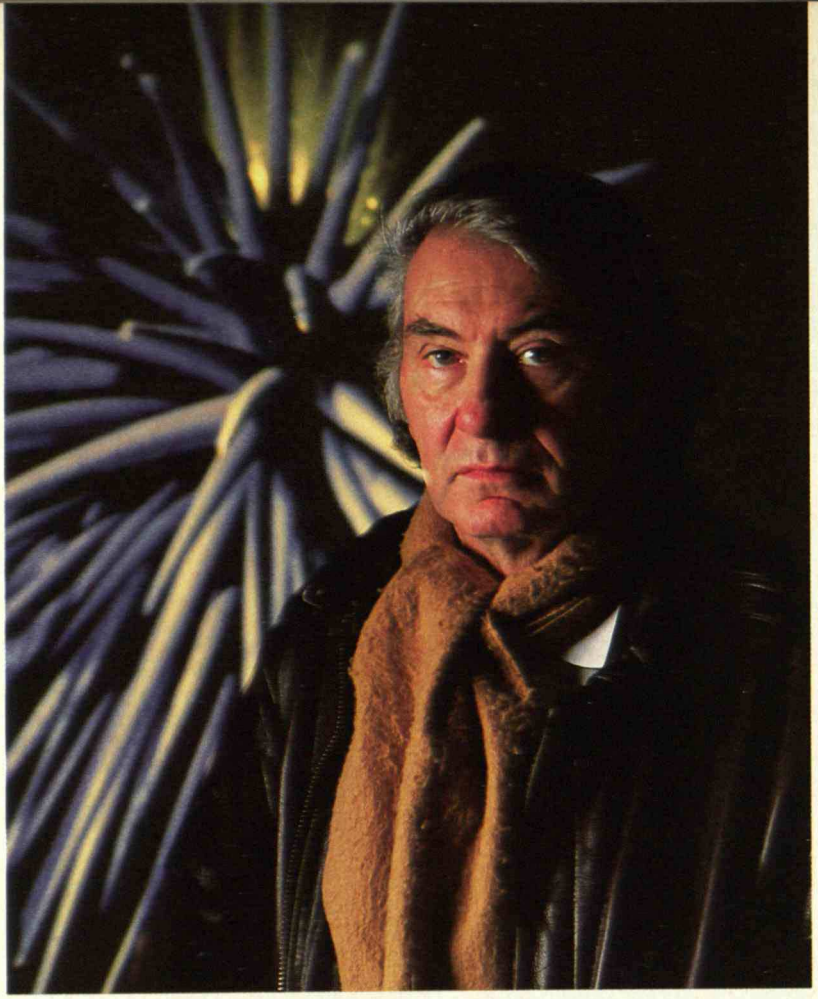
This opposition has not stopped artists from proposing other space sculptures, although some have tried to take scientists' objections into account. For instance, artist James Pridgeon has proposed a space sculpture consisting of a pair of tethered reflecting balloons, to be launched in conjunction with the next International Goodwill Games in Seattle later this year. Based on technology used in the *Echo* satellites of the early 1960s, the balloons would be filled with about 30 pounds of inert powder and stored in a canister. When the canister opens in orbit, the vacuum of space causes the powder to "sublimate," or turn into a gas, inflating the balloons. The work, which Pridgeon conceives as a symbol of goodwill and collaboration, would be funded privately in the United States and launched by the Soviet Union. It would remain in space only a few weeks and at a low enough orbit to be visible only at dusk and dawn. Pridgeon plans to set up an information network to let astonomers know the exact times at which the sculpture will be passing by.

Artist Arthur Woods and aerospace engineer Marco Bernasconi have planned an ambitious series of space sculptures as part of their OURS (for "Orbiting Unification Ring Satellite") Project. The first OURS sculpture is a ring, roughly 20 to 30 feet in diameter, divided by a cross in the center—the symbol for Earth. It is scheduled for launching by the Soviet commercial space agency Glavcosmos from the *Mir* space station in 1992, the International Space Year. The sculpture would not be visible from the ground but would be filmed from space by cameras aboard the *Mir*. Atmospheric drag would cause it to burn up in the earth's atmosphere in a matter of days.

The ultimate goal of the OURS Project, for the year 2000, is to place in orbit a much larger ring about 1 kilometer in diameter. A symbol of planetary unity, the ring would celebrate the passage of the human species into the next millenium. Every day, about 10 minutes before sunrise and after sunset, it would be visible as a circle or ellipse in the sky. Eventually, it would deploy a solar sail that would intercept enough

PHOTOS: OURS PROJECT/JAMES PRIDGEON/OURS PROJECT





Opposition from scientists has led some space artists to political activity. One group that includes Otto Piene (left), director of the MIT Center for Advanced Visual Studies, has issued a "Sky Artists and Space Artists' Manifesto." Some 200 artists have signed it.

MIT artist Joe Davis has proposed a work that would fly in a space-shuttle "Getaway Special" payload container (right, bottom inset). It would use a pulsed electron gun—the core of which is a tiny cathode heater (top inset)—to create artificial auroras. These would be visible from the ground during a shuttle flight (right).

light from the sun to propel the sculpture out of Earth orbit by light pressure.

Both OURS sculptures would be made from a novel fabric developed under contract for the European Space Agency's technology program. The fabric is a laminate of very thin metal sheets impregnated with a chemical resin that hardens in sunlight. Using this material allows the sculptures to be folded into a compact shape for easy storage in the hold of a spacecraft. But once placed in orbit and illuminated by the sun, they will become rigid.

Space Artists' Manifesto

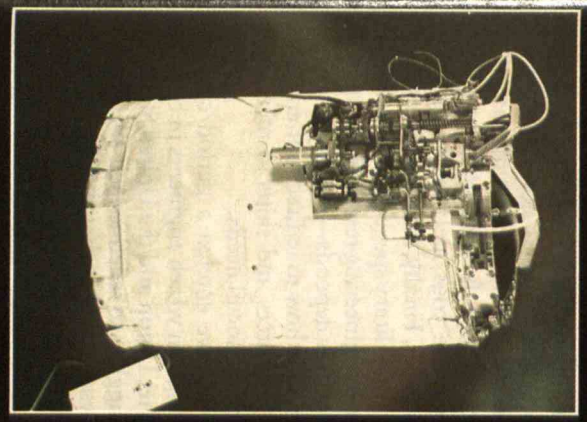
Even these projects, which would be visible only for a limited time, have drawn criticism from scientists. Donald Osterbrock, president of the American Astronomical Society, has argued that even if executed with great care, orbiting space art would hinder astronomical observation. Canceling Pridgeon's Goodwill Games project, Osterbrock has said, "would in itself be an excellent symbol of international goodwill." And astronomer Carl Sagan has declared that even if astronomers found a particular proposal for a space sculpture acceptable, allowing it would set a dangerous precedent.

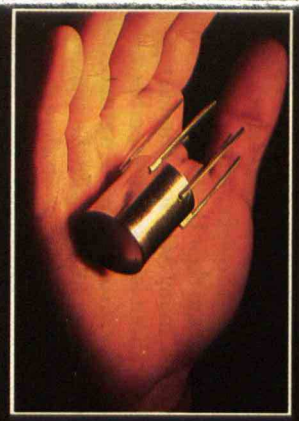
Such opposition reflects the continuing schism between the two cultures of science and the arts. It also highlights the need for some neutral forum to screen proposals for space art. Professional scientific societies can represent only the vested interests of their members and have no power to enforce any restrictions they recommend. And unlike laws that govern public art on city streets, space law does not yet provide mechanisms to evaluate or regulate art in space.

As a result, some space artists have turned to politicking. A group that includes artist Otto Piene, the director of MIT's Center for Advanced Visual Studies, has issued a "Sky Artists and Space Artists' Manifesto" calling for the creation of national and international councils to review space art projects. Some 200 artists have signed it. French space artist Jean-Marc Philippe has proposed establishing a Space Art Ethics Committee within the European Academy of Arts and Sciences to develop guidelines that address the interests of all the communities involved. Both proposals were presented at the 1986 UNESCO Conference on Culture and Space. No action has been taken on them yet, but just last year the International Academy of Astronautics established a subcommittee on the arts and literature as a forum for discussing issues raised by space art.

Perhaps such initiatives will encourage widespread public discussion of what kinds of space art are acceptable, and help define an approval process for individual projects. Space exploration is the greatest voyage of discovery ever undertaken. Artists should be active participants in it. ■

PHOTOS: JOE DAVIS/L. BARRY HETHERINGTON





Glasnost and Engineering

THE dramatic events transforming Eastern Europe sent reverberations through a conference I attended recently on "Technology and Democracy." The presence of Vitaly Gorokhov, the sole Soviet participant, bore witness to the fruits of *glasnost*. So did the subject of his paper: the tragic history of Soviet engineering.

It was encouraging to see this soft-spoken scholar from the Academy of Science of the USSR exploring important historical issues that until recently were suppressed. And it was intriguing to realize that while U.S. and Soviet engineers do not share the same history, they are asking some strikingly similar questions about their place in society.

A widely held belief about the Soviet Union is that communism helped engineering to flourish. The numbers seem to bear this out. Fully half the world's engineers are Soviet. In 1980, 80 percent of the members of the Politburo had engineering degrees. From the earliest days of the Russian Revolution, the Party championed technical education as a path to advancement within the hierarchy, a strategy intended to stimulate industrialization and help the country catch up with the West.

As the current stagnation of the Soviet economy suggests, however, the sheer quantity of engineers has not translated into technical proficiency. Gorokhov offers some reasons why.

During the first two decades of this century, the vocation of engineering in Russia grew steadily, following organizational lines similar to those in Europe and the United States. Engineers formed professional associations, founded periodicals, and worked to expand engineering education. At first, Gorokhov argues, the Bolshevik revolution enhanced this development. During the early and middle 1920s, the Soviet government looked to educated engineers to play an important role in reshaping the economy.

The honeymoon ended with Joseph Stalin's rise to power. Stalin insisted that the future of the Revolution rest exclusively in the hands of workers, and that



In a period of rapid change, both Soviet and U.S. engineers are struggling to redefine their social roles.

suspected bastions of bourgeois privilege be rooted out. In 1929, the Party accused the All-Union Association of Engineers, the most prominent engineering body at the time, of elitism and worse. Some engineers were charged with industrial sabotage, convicted in heavily publicized show trials, and sent to labor camps. While the careers and lives of many talented engineers were being destroyed, Soviet publications shamelessly proclaimed Stalin "the great engineer of human souls."

In succeeding decades, the Soviet state continued to stress engineering as a career. But standards of technical education and practice fell drastically. Professional associations no longer existed to exercise independent judgment and ensure quality control. Many engineering schools became little more than diploma mills. During Stalin's reign of terror, the safest path for competent technical specialists was to move into the state bureaucracy—as far away from real-world industrial problem solving as possible. Thus, while bureacrats formulated ambitious five-year plans and production quotas, the practical ability to carry them out rapidly deteriorated.

Drawing lessons from this calamity, Gorokhov calls for increased freedom and democracy—and not only for engineers and other professionals, but in all spheres of society. For the Soviet economy, he favors combining state planning and the market, with decentralized control of resources and widespread democratic participation in important technical decisions. And observing that "contemporary engineers have to deal with both human and technical systems," he urges increased attention to engineering ethics and the study of the humanities.

At first glance, it would seem that the experiences of Soviet engineers have little relevance to their U.S. colleagues. But ironically, many American engineers are talking about issues that resemble ones raised by Gorokhov. Engineering schools are grappling with the question of how best to educate students to address new economic and social challenges. And although engineers in this country have never faced political repression, there is concern that engineering is losing its status as an independent profession, turning engineers into mere cogs in large bureaucratic machines. Finally, the prospect of major cuts in military spending—on which so much engineering research and employment now depends—may soon force us to decide how to redirect our engineering resources and skills to meet more pressing social needs.

We have entered a period of rapid change, in which engineers in both the Soviet Union and the United States are struggling to redefine their social roles. It would appear that they have a great deal to discuss. ■

LANGDON WINNER teaches in the Program on Science and Technology at Rensselaer Polytechnic Institute. His most recent book is The Whale and the Reactor.

ILLUSTRATION: FRAN O'NEILL

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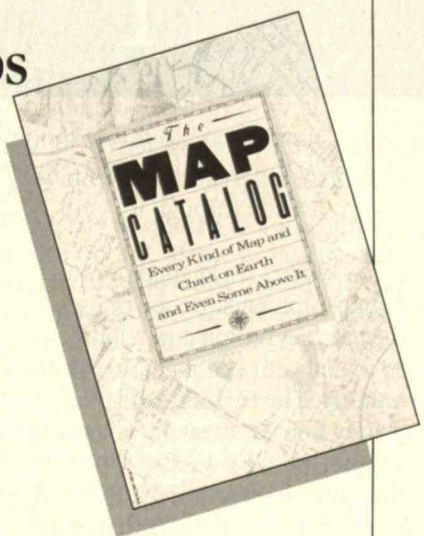
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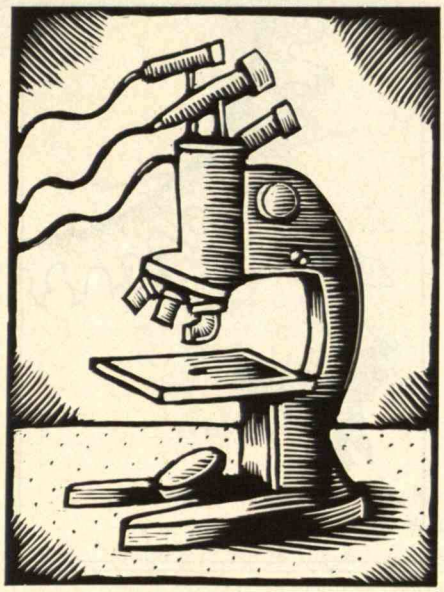
Science, Politics, and Perspective

BIOLOGICAL science is part of the political mainstream these days, at the center of important and controversial public issues. The pronouncements of biologists affect public policy. Our ideas—even ill-considered ones—make headlines. For this reason, well-known scientists in positions of public responsibility need to consider carefully the implications of their views. Unfortunately, as recent statements by two prominent biologists show, this isn't always the case.

Moving into government seems to have cost James Dewey Watson some perspective. One would think that Watson, a co-discoverer of the structure of DNA, would care about the primacy of the quest for knowledge in science. But in his new job directing the human genome initiative at the National Institutes of Health, he wrote a letter to Kenichi Matsubara, the head of Japan's genome program, that suggests a changed set of values. Watson threatened to keep the results of U.S. genome research from Japanese scientists unless their country started making significant financial contributions to the Human Genome Organization (HUGO). This is an international group for coordinating national genome efforts.

Watson's letter implies that access to basic scientific results should be limited to those who pay for them. This runs counter to all experience in molecular biology—a field characterized by unfettered sharing of results—and should lead scientists to reflect on why we do research in the first place. Our primary purpose is to uncover nature's secrets. In the process, we learn how to counter some of nature's scourges and even develop new industries. But that is not the driving force behind our work.

For many people not in basic science, however, the applied results are the *raison d'être* for the science. For them, science's main value is as a generator of commerce and technological progress. Unless scientists themselves vigorously defend the value of basic research, there will be no one to speak for it. By threatening to cut off free access to data—whether



Scientists need to be more careful about their public statements.

or not that is logistically feasible—Watson is putting the values of commerce above those of science.

Why this apparent reversal? Some people believe that the genome project will benefit biotechnology and pharmaceutical companies by helping them develop diagnostic tests and drugs. Perhaps because these commercial consequences of the initiative have been so highly emphasized, Watson thinks he must speak for commercial interests. But that is a disservice to those who care most about the health of basic research. The human genome initiative should be a low-profile effort coordinated through the usual scientific exchange at meetings open to all. And HUGO should smooth the way, not furnish an excuse for blackmailing countries that do not pay as much as others and may have very different priorities.

Another issue embodying the controversial cross-currents of science and politics is AIDS research. Witness the comments of Robert Gallo, the NIH's foremost AIDS researcher, at a Vatican conference on AIDS last fall. As quoted in the *New York Times,* Gallo told his audience that "an anti-AIDS vaccine could be available for some patients by 1991 or 1992."

Unfortunately, Gallo is almost certainly wrong. While it is true that anything might happen, the likelihood of a vaccine to prevent AIDS being available within five years—let alone one or two—is extremely low. The biomedical community is working hard on a vaccine but has far to go. A few monkeys have been protected against the simian relative of HIV. They were innoculated with killed virus particles that induced very high antibody levels. But that is a long way from an effective vaccine for humans.

It is counterproductive to promise that an AIDS vaccine will come soon, because it makes prevention seem less urgent. Furthermore, to predict an early vaccine while standing in the Vatican lends undue credence to those who say public health officials fulfill their responsibility merely by preaching old-fashioned morality. For example, in the same news story that reported Gallo's prediction, New York's Cardinal O'Connor was quoted as condemning "the dishonesty of those health care professionals who refuse to confront the moral dimensions of sexual aberrations or drug abuse," concluding that "good morality is good medicine."

Was Gallo headline hunting? Was he carried away by the august surroundings and the presence of the Pope? Or was he simply saying what he wanted to believe to an audience eager to hear it? Whatever the reason, he would have better served AIDS research by being conservative and emphasizing the difficulties ahead. And both science and the public would be better served if scientists made public statements only after carefully weighing the consequences. ■

DAVID BALTIMORE, a Nobel laureate, is director of the Whitehead Institute for Biomedical Research and professor of biology at MIT.

ILLUSTRATION: RANDY LYHUS

Reviews

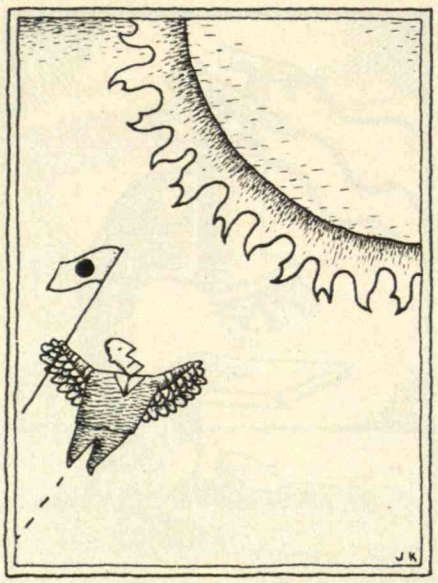
BOOKS

JAPAN'S ECONOMIC FUTURE

The Sun Also Sets:
The Limits of Japan's Economic Power
by Bill Emmott
Times Books, $18.95

Created in Japan:
From Imitators to World Class Innovators
by Sheridan M. Tatsuno
Harper & Row, $21.95

BY TAKASHI HIKINO



THE Japan boom in book publishing continues. The latest *Books in Print* contains more than 150 such titles, covering almost every aspect of Japan's economy and business. (By contrast, the economy of Germany—another successful industrial nation—rates fewer than half as many books.) *The Sun Also Sets* by Bill Emmott and *Created in Japan* by Sheridan Tatsuno emphasize that even as Japan has taken its place as an economic superpower, it has been undergoing a major transformation. Both books attempt to describe this process and suggest what it means for the world economy.

Emmott and Tatsuno agree that the changes in Japan will affect its future economic role. But they disagree on what the transformation consists of and where it will lead. This is because they have contrasting perspectives on the character of Japanese society.

For Emmott, a well-informed journalist who served as the Tokyo bureau chief of *The Economist,* everything is economic and nothing is cultural. The Japanese are not a special case, he argues; they respond to macroeconomic incentives just like people in other modern industrial societies. As their incomes rise, they spend more and save less. Thus, after decades of extraordinary saving, the Japanese are turning to a consumption-oriented economy in which they buy more and more goods, both domestic and foreign. This means that Japan is not a dangerous industrial juggernaut, but simply one economic power among many.

For Tatsuno, an industry analyst and consultant based in California, culture is more important than economics. He believes that distinctive features of the country's culture give Japan special advantages in the technology-based global economy of the future. From this point of view, the 1980s mark the beginning of a new era for Japanese technology, in which a clever copycat becomes a world-class innovator and even more formidable competitor.

The problem with both arguments is that they simplify extremely complex social and economic issues. Like the proverbial blind men describing the elephant, each author takes one aspect of a multifaceted topic and turns it into an all-embracing principle. The weakness of both these books is the analytical frameworks the authors bring to their subject.

A Nation of Consumers?

In *The Sun Also Sets,* Emmott accepts the common notion that Japan has traditionally been a society of savers. The gap between high personal savings and low domestic demand resulted in an enormous capital surplus, which Japan poured into foreign investment—in particular, financing the U.S. budget and trade deficits.

But if macroeconomic forces have led Japan to play global financier, Emmott argues, the same forces are now causing a reversal. The Japanese have started enjoying their new prosperity by spending more. Young people are choosing to work less and to spend more time and money on leisure. Pensioners, a rapidly growing segment of the population, are using up their savings to fund their retirement.

Sooner or later, as these trends continue, the Japanese capital surplus will run out. Japan will become a more inward-looking economy, oriented toward domestic consumption. Because Japan also lacks leadership in international political and military affairs, the United States will remain number one in the world, and Japan will follow as a strong number two.

Of course, this scenario depends on many assumptions—particularly about future Japanese saving rates, which even Emmott acknowledges are extremely difficult to project. To accept his view, readers have to believe in the general accuracy of economic forecasting techniques—but given the uncertainty of the data, that calls for a major leap of faith.

In making his argument, Emmott covers a wide range of topics related to Japan. Thus, his book is a valuable source of information on that country. At the same time, its diversity makes for an unavoidable unevenness. In general, Emmott is at his best when he makes his case by dispelling myths about the Japanese system. But when he tries to fit his findings into the procrustean bed of his macroeconomic perspective, his tone becomes textbookish and flat. Worse, it keeps him from investigating that area where Japan really does differ from other developed nations—industrial organization, or the way companies are managed and products designed and manufactured.

ILLUSTRATIONS: JAMES KACZMAN

Or a Nation of Innovators?

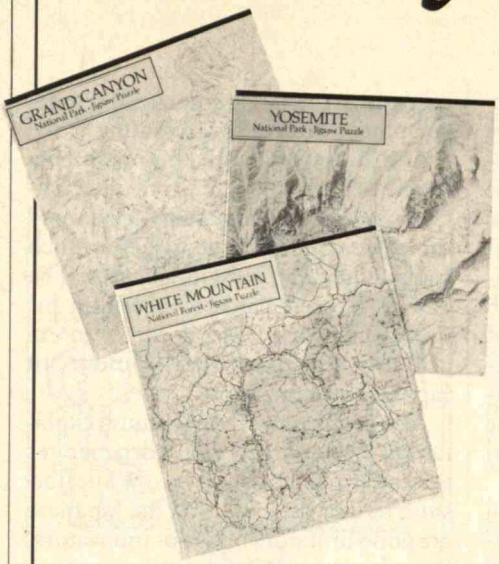
In *Created in Japan,* Tatsuno does focus on industrial organization. He aims to show that Japan is transforming itself from an economy based on improving products designed elsewhere to one based on creating new high-tech products. This is a matter of necessity, Tatsuno stresses, because international competition in mature industries like steel and automobiles has become too severe for Japan to continue making high profits. The author argues that Japanese culture is in some ways ideally suited to a move toward innovation.

According to Tatsuno, Zen Buddhist philosophy provides a solid intellectual foundation for creativity. This rich source of insight, he maintains, is finally emerging in scientific and technological fields. Tatsuno even goes so far as to claim—although he never presents much evidence for it—that clues for innovative robot design can be found in the traditional art of flower arrangement, and that the aesthetic principle of trained growth symbolized in bonsai is directly applicable to bioengineering.

Because of these cultural resources, says Tatsuno, Japanese creativity takes a different form from that of the West. Western creativity stresses a linear process of dramatic breakthroughs by individuals. By contrast, the Japanese view creativity as a more adaptive process, occurring in incremental cycles where groups of people, rather than individuals, make the major contributions, and where breakthroughs are less important than recycling, exploring, cultivating, and refining.

Tatsuno illustrates this process in such leading-edge technologies as high-definition television (HDTV), next-generation computers, and superconductors. Initially, a government ministry such as MITI establishes a research project for developing a product. A few Japanese academic experts may take part as advisers. Then some large enterprises in related industries join the project, or organize parallel projects of their own. As these initiatives progress, other firms and ministries participate.

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Some of these projects have been successful, as in the case of HDTV, where a state-controlled broadcasting corporation has made significant progress in developing and commercializing a new technology. But others have not achieved their assumed goals. For instance, the much publicized Fifth Generation Computer Project has not yet resulted in any concrete product development. Yet despite these mixed outcomes, Tatsuno predicts that "by the mid-1990s, Japan's technological prowess could overwhelm the West."

Unlike Emmott, who focuses on broad demographic and macroeconomic trends, Tatsuno excels in detailing the way Japanese companies and government bureaucracies work. Readers get a good picture of the dynamics of Japanese product development. In particular, Tatsuno's description of the cooperation and competition among ministries and companies within a development project is fascinating.

On the other hand, the organizing theme of his book—a cultural interpretation of Japanese creativity—is simply too abstract and vague to be of much use in analyzing individual cases. The author himself tends to abandon his own framework when it comes to exploring product development in Japanese organizations.

The problem with this cultural explanation is that it too easily degenerates into a simplistic stereotype. While Tatsuno refutes the myth that the Japanese are good imitators but poor innovators, he ends up replacing the old stereotype with a new one. He also stereotypes the "Western" approach. He confuses "Western" with "American," he never substantiates the idea of a single American innovative pattern, and he never really explains why Japanese creativity is more suited to the demands of the world economy.

In the end, both Tatsuno's world of Zen product development and Emmott's reassuring vision of a nation of ordinary consumers are about the strength of Japan relative to other nations, especially the United States. However, to understand the strengths and weaknesses of these two societies would require a careful treatment of economic and industrial developments on *both* sides of the Pacific. Both books gloss over U.S. economic developments. Tatsuno substitutes his stereotype of Western innovation for in-depth analysis. And Emmott's solution to complex problems like the poor performance of U.S. manufacturing is more macroeconomic fine-tuning—as if that will be enough to ensure America's dominance in the world economy.

Next time, Tatsuno might try following one of the fundamental teachings of Zen: to look at the whole picture without prejudice. And Emmott should remember that while the sun also sets, it usually sets in the west. ■

TAKASHI HIKINO is a research associate at the Harvard Business School, specializing in international business development.

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BOOKS

TECHNOLOGY'S CRITIC

Lewis Mumford: A Life
by Donald L. Miller
Weidenfeld & Nicolson, $24.95

BY ROBERT HOWARD

LEWIS Mumford is one of the great twentieth-century American writers. In a career spanning more than half a century, he wrote on an extraordinary range of subjects, including urban planning, architecture, American literature, cultural history, and social philosophy. But tying Mumford's work together, giving it power and coherence, is his stubborn preoccupation with a single theme—the human and social costs of modern technological civilization.

In the 1920s and '30s, when most people took the benefits of technology for granted, Mumford became America's foremost critic of technology and its role in the modern world. Ironically, now that criticism of technology abounds, few people are familiar with his work.

This is a good reason to welcome historian Donald Miller's comprehensive biography. *Lewis Mumford: A Life,* the first biography of Mumford (who is 94 and retired from public life), is a masterful introduction to his life and work, and a thorough evaluation of his intellectual legacy.

In Search of the Organic

Born in New York City in 1895, Mumford at first shared in the widespread turn-of-the-century enthusiasm for technology. As a boy, he dreamed of becoming an electrical engineer, and attended New York's prestigious Stuyvesant High School, which prepared students for careers in science and engineering. By the end of high school, Mumford had dropped that

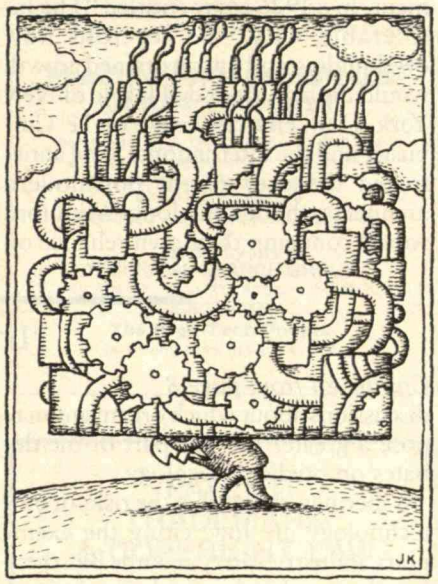
plan to become a writer, but he retained a passionate interest in technology and came to see it as a shaping force in modern society.

By far the most important intellectual influence on Mumford was the Scottish botanist, sociologist, and town planner Patrick Geddes. From the time in 1914 when he first happened upon Geddes's books in the biology department library at the City College of New York, Mumford saw Geddes as his intellectual mentor.

Geddes, writes Miller, had "a biologist's sensitivity to organic relationships," which he applied to the study of social organisms such as the city—a method Geddes called "bio-sociology." Geddes was a pioneer of ecological thinking—the idea that no organism could be understood in isolation from its environment. His organic perspective profoundly shaped how Mumford saw the world and what he found missing in it—in particular, Mumford's perception of the ways technological civilization destroyed the social bonds that give form, unity, and meaning to life.

Mumford used Geddes's methods to become one of the first critics of the modern metropolis. He argued that the reckless drive for profit and physical expansion in the modern city—symbolized by the skyscraper—was destroying the human connections that made cities livable. Borrowing ideas from the British "garden city" movement, Mumford proposed that mid-sized "new towns" be created as an alternative to unrestrained growth in existing cities. These regional urban centers, he believed, would be the catalyst for a new era of decentralized economic growth.

In his architecture criticism (much of it collected in his famous "Sky Line" column, which he wrote for the *New Yorker* from 1931 to 1963), Mumford welcomed modern architecture as an antidote to the tendency of many architects in the 1920s and '30s simply to copy historical forms. But he rebelled against the imposition of a single International Style, particularly the cold functionalism of Le Corbusier. Mumford's search for an "organic architecture" that balanced the traditional and the modern led him to become the first champion of the great American architect Frank Lloyd Wright.



Mumford's writings on technology and culture set out most clearly his basic criticism of technological society. Mumford was not opposed in principle to technology and the benefits it could bring. Indeed, his concern about the dominance of the "machine" in modern life was less a rejection of any particular technology than a criticism of an entire way of thinking.

"Men became mechanical before they perfected complicated machines," Mumford wrote in *Technics and Civilization,* published in 1934. Long before the great age of technological invention, he argued, Western society had committed itself to a set of values—material progress, the absence of limits, growth as the supreme imperative—that corroded human freedom. Modern science had contributed to this development. Its urge to comprehend and control the physical world led it to define as "real" only those parts of reality that could be empirically verified. But this ignored an entire dimension of subjective human experience. The result was a "mechanistic mode of life," geared to the pace of high-speed technology and committed to the ideals of specialization, automation, and a narrow rationality that ignored questions of social value.

Early in his career, Mumford hoped that new technologies might undermine this reliance on centralization and control. In *Technics and Civilization,* he predicted that electric power and the automobile would make possible the creation of a decentralized economy and regional cities to replace the crowded urban centers produced by the era of steel and coal.

But by the late 1960s, Mumford had become far more pessimistic. In his magnum opus, *The Myth of the Machine,* he traced the dominance of the mechanistic outlook back to antiquity—specifically, to the forced-labor gangs that built large public works in the first cities. Although these crude social organizations consisted of people instead of mechanical parts, Mumford considered them the first "machines." For they perfected the principles of specialization and control that would come to typify modern technology.

Only a revolution in cultural values could end so persistent a world view, Mumford argued. He called for a social philosophy emphasizing the destructive capacity of modern technology and rejecting the idea that economic growth was the *sine qua non* of human progress. Only through such attitudes would humanity regain control of the machine and be able to use technology for social ends.

An Imperfect Prophet

It is easy to find much to disagree with in Mumford. What Miller describes as the critic's "priestly certainty" can be maddening—particularly on subjects like the rise of the first cities, where the lack of evidence leaves little room for anything but conjecture. And Mumford's use of history as an instrument for moral prophecy sometimes makes him a bad historian. More disturbing still is the frequency with which Mumford's powerful critique of technological civilization deteriorates into self-righteous moralizing, at times bordering on con-

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tempt for scientists and technologists.

And yet, what is consistently striking in Miller's account is Mumford's prescience. His embrace of holism and regionalism prefigured many themes of the modern-day environmental movement. In a 1926 essay entitled "The Intolerable City," he foretold how overbuilding and unconstrained growth would destroy the social fabric of New York City. His criticisms of Le Corbusier and the International Style anticipated those of recent postmodern architects (though no doubt Mumford would condemn their own reliance on a pastiche of historical styles). And his opposition to nuclear power in the early 1950s—on the grounds that safe methods for disposing of nuclear waste had yet to be discovered—presages the headlines of today.

For all these reasons, Mumford's writings remain thoroughly contemporary. With luck, Miller's exhaustive biography will be a catalyst for their rediscovery. ■

ROBERT HOWARD is a senior editor at Technology Review.

Continued from page 8

discussions about which organisms may pose a greater risk are part of the debates on predictive ecology.

Liberman claims that the risks of biotechnology are low, citing the exemplary industry safety record. But there have been only a few field experiments, and no one can build a record on such a small sample. In our article, my coauthors and I had to focus primarily on intentional releases of organisms.

As for the issue of how biotech will affect farming, products such as bovine growth hormone and transgenic animals have met with opposition from small farmers who are worried about higher capitalization costs and lack of concern for animal husbandry.

Finally, to set the record straight, the only areas in which I have supported a biotech research ban are biological weapons and the genetic modification of the human germline. I helped write the Cambridge recombinant-DNA ordinances of 1976 and 1980, which settled local controversies over the safe conduct of science and industry.

"START SPREADING THE NEWS . . ."

I hope that Ellen Brennan, the "policy analyst" Ann Marie Cunningham quotes in "Megacities" (*TR July 1989*), knows more about other "megacities" than she does about New York. I also hope that Cunningham herself learns to read the New York papers. The article's entire thesis is wrong: New York has little in common with big young Third World cities. The economics, sociology, and politics are entirely different.

Brennan's contention that New York's infrastructures have become "woefully inadequate" is absurd. So is her complaint that "there's little money to do more than patch things up." In fact, the city is spending billions on its infrastructures—a new water tunnel under Long Island Sound, a new sewage plant in the Hudson River, completely rebuilt bridges, reconstructed streets. The borough halls in Manhattan and Brooklyn are being totally remodeled at fantastic expense. Whatever may be wrong with New York, it is not lack of money for infrastructures.

Moreover, Cunningham is mistaken in her belief that New York, "like its sisters," is monocentric, with workers commuting to one central district. Anyone who has ever been to downtown Brooklyn or Long Island City—not to mention Fort Lee or White Plains—knows that this is not true. Nor is it true of Mexico City, the only other "megacity" with which I am acquainted.

Finally, the article contains a glaring non sequitur. First Cunningham quotes Brennan as saying that there are vast expanses of empty land near Manhattan. Then, in the very next sentence, she says Brennan "maintains that available property is just as scarce in the centers of cities like Delhi and Karachi."

LEE LEVITT
New York, N.Y.

The author responds:

Brennan meant that much Manhattan land is empty because it is in private hands and kept undeveloped by speculators. Land available for development is just as scarce in the megacities where most of it is publicly owned.

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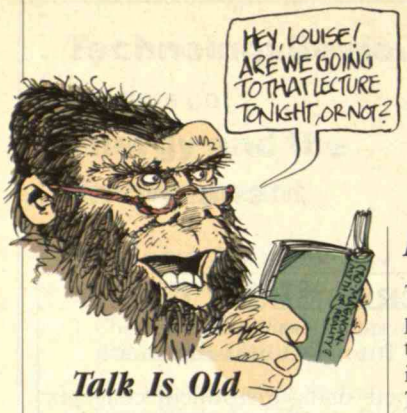
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Notes



Talk Is Old

About 50,000 years ago, modern humans migrated from Africa to Europe, where they met and fought with Neanderthals. Harvard anthropologist Terrence Deacon suggests the two parties might have talked to each other as well. He maintains that Neanderthals "had every bit of the intellectual and linguistic capability" our direct ancestors did.

Deacon reckons that language may go back 2 million years, not 50,000 years, as most anthropologists have said. He thinks a Neanderthal's prefrontal cortex, critical for language, resembled that of modern humans. True, they had sloping foreheads and prominent brows, but their gray matter was organized like ours.

Risky Talk

■ Media always exaggerate public-health risks.

■ The public always wants simple, cut-and-dried answers when dealing with risks.

■ If messages about risks are clearly communicated, people believe them.

All three assertions are wrong, says *Improving Risk Communication*. The National Research Council (NRC) report says such misconceptions seriously hamper government, industry, and public discussions of health and environmental hazards.

For example, risk communication is often a one-way street—from experts to others. But it should be two-way, an "interactive process of exchange of information and opinion among individuals, groups, and institutions."

Responsible Science

To guide graduate students on professional conduct, the National Academy of Sciences has issued *On Being a Scientist*. The 22-page booklet addresses such questions as how much confidence a researcher must have in an experiment's results before publishing them, how scientists can avoid self-delusion, and what researchers should do if they suspect colleagues of scientific misconduct.

"Our hope is that this document will instill in future scientists a sense of the importance and values of science, as well as the social responsibility that goes with it," says biologist Francisco Ayala. He chaired the committee that prepared the booklet, which is going to 120,000 students, faculty, and others.

Safe Tankers

Swedish engineers suggested in 1985 that oil tankers be built or refitted so that the empty space at the top of a cargo-hold is airtight. Were the hold punctured, air would be pumped out, so atmospheric pressure on the water around a ship could stem oil spillage.

The Economist reports that the idea was proposed at the U.N. International Maritime Organization two years before the *Exxon Valdez* disaster. It was also advanced in leading industry publications. Yet after the Alaska spill, the director of transport for the American Petroleum Institute, which represents major U.S. oil firms, told the British magazine that "until now nobody has brought it to our attention."



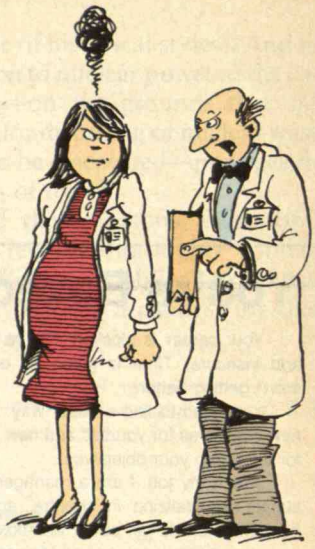
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Warming Alert

Since last fall, TV and radio stations have run the Environmental Action Foundation's public service announcement (PSA) on global warming. But when the spots first appeared, the Motor Vehicle Manufacturers Association told stations it would "demand equal time to rebut the misinformation and misleading material they contain." The PSAs aired, and the manufacturers never made their objections explicit. The spots read, in full:

"Global warming is a disease of the earth. Its most alarming symptom is a rise in the earth's temperature, like a fever. Its effects can be disastrous. A major cause of global warming is the car, which pumps 2 billion tons of hazardous gases into the atmosphere every year. We need to make fuel-efficient cars, and we need to use them more efficiently. Like many diseases, global warming can be treated, and with your help, the prognosis is good."



Polls I: Women at Work

Despite harassment, women engineers like their work, according to a survey directed by the Cooper Union's Eleanor Baum, the only U.S. female dean of engineering.

Nearly 90 percent of the 4,000 respondents say their careers offer important work and membership in a respected profession. But many complain that young women seeking this career get inadequate support from teachers and guidance counselors.

Nearly two-thirds say they must work harder than men doing comparable jobs. Three-fifths believe that merit raises are gender-blind, but 35 percent feel that men are promoted faster. Thirty-nine percent feel penalized for taking maternity leave. More than half have suffered on-the-job harassment. And a fifth say their work creates serious marital conflicts.

Polls II: Tech Talk

West German researchers have collated 120 opinion polls about technology taken in several countries over 15 years. A mere 23 percent of those polled in Japan believe that scientific progress will benefit humanity, compared with 33 percent in West Germany and 37 percent in France. People in English-speaking nations are only a bit more optimistic.

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